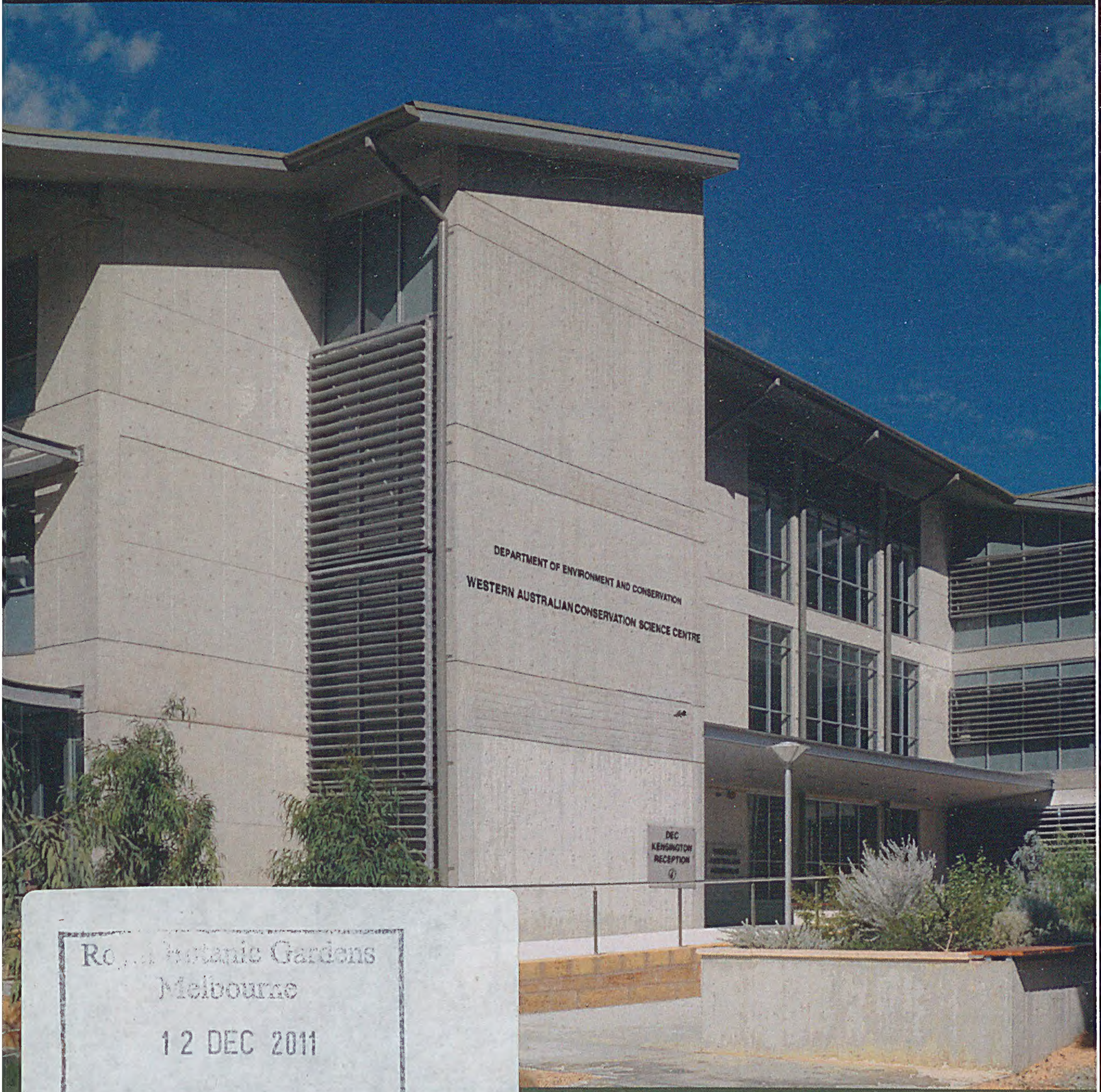
Nuytsia

WESTERN AUSTRALIAN HERBARIUM
VOLUME 21 (3) PAGES 91–156 2011


DEPARTMENT OF ENVIRONMENT AND CONSERVATION
WESTERN AUSTRALIAN CONSERVATION SCIENCE CENTRE
DEC
KENSINGTON
RECEPTION

Royal Botanic Gardens
Melbourne
12 DEC 2011
LIBRARY

Department of
Environment and Conservation

Cover

The Department of Environment and Conservation's new Western Australian Conservation Science Centre, which incorporates the Western Australian Herbarium (PERTH).

Photograph: K.R. Thiele

Nuytsia

WESTERN AUSTRALIAN HERBARIUM

VOLUME 21(3) PAGES 91–156 2011

Royal Botanic Gardens
Melbourne
12 DEC 2011
LIBRARY

DEPARTMENT OF ENVIRONMENT AND CONSERVATION
WESTERN AUSTRALIA

Nutysia

Nuytsia is a peer-reviewed journal that publishes original papers and short communications on the systematics, taxonomy and nomenclature of Australian (particularly Western Australian) plants, algae and fungi.

Descriptions of taxa, revisions, identification guides, nomenclatural and taxonomic issues, systematic analyses and classifications, censuses, and information on invasive species are all considered.

Nuytsia is an open access journal in which papers are made freely available on the web. There are no page charges.

Information for authors and instructions for purchasing hard copies of each volume or part can be found on the journal's website: http://florabase.dec.wa.gov.au/nuytsia.

All papers should be submitted electronically in MS-Word format to:

The Managing Editor, *Nuytsia*
Email: nuytsia@dec.wa.gov.au
Telephone: +61 8 9219 8000
Facsimile: +61 8 9334 0327

Postal address:
Western Australian Herbarium
Science Division
Department of Environment and Conservation
Locked Bag 104, Bentley Delivery Centre
Western Australia 6983

Enquiries regarding distribution and subscriptions should also be addressed to the Managing Editor.

Department of
Environment and Conservation
Our environment, our future

Editorial Committee

Scientific Editor — Kevin Thiele
Managing Editor — Beng Siew Mahon
Subeditors — Ryonen Butcher
Alex Chapman
Terry Macfarlane
Barbara Rye
Kelly Shepherd
Juliet Wege
Curation — Meriel Falconer

Published by the Department of Environment and Conservation, Locked Bag 104, Bentley Delivery Centre, Western Australia 6983.

© Copyright Department of Environment and Conservation 2011. All material in this journal is copyright and may not be reproduced except with the written permission of the publishers.

ISSN 0085-4417

Publication date for *Nuytsia* Volume 21(2):
29 August 2011

CONTENTS

Papers **Page**

Labichea rossii (Fabaceae: Caesalpinioideae), a new species from the Yilgarn Ranges, Western Australia. N. Gibson 91

A new and rare species of *Ptilotus* (Amaranthaceae) from a suburban wetland of the eastern Swan Coastal Plain, Western Australia. R.W. Davis and C. Tauss 97

An assessment of some infraspecific taxa in *Ptilotus* (Amaranthaceae) from Western Australia. R.W. Davis 103

A revision of *Dielsiodoxa* (Ericaceae: Styphelioideae: Oligarrheneae). D.E. Albrecht and M. Hislop 107

Sida picklesiana (Malvaceae), a new species from the Murchison-Gascoyne region of Western Australia. A.S. Markey, S. Dillon, G.T.B. Cockerton and R.M. Barker 127

Two species of *Inocybe* (fungi) introduced into Western Australia. N.L. Bougher and P.B. Matheny 139

Short Communication

Re-evaluation of some infraspecific taxa in *Ptilotus* (Amaranthaceae). R.W. Davis 149

Validation of the name *Drosera monticola* (Droseraceae), a species from the south-west of Western Australia. A. Lowrie 152

Melaleuca marginata, a new name for *Melaleuca coronicarpa* (Myrtaceae). M. Hislop, B.J. Lepschi and L.A. Craven 153

Corrections 155

Royal Botanic Gardens
Melbourne
12 DEC 2011
LIBRARY

Labichea rossii (Fabaceae: Caesalpinioideae), a new species from the Yilgarn Ranges, Western Australia

Neil Gibson

Science Division, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
Email: neil.gibson@dec.wa.gov.au

Abstract

Gibson, N. *Labichea rossii* (Fabaceae: Caesalpinioideae), a new species from the Yilgarn Ranges, Western Australia. *Nuytsia* 21(3): 91–95 (2011). A new rare species of *Labichea* Gaudich. ex DC. is described from a ridge of Banded Iron Formation in the ranges near Mt Holland. Unlike most species in the genus, this new species, *L. rossii* N.Gibson, has very dissimilar petals more reminiscent of flowers from subfamily Faboideae.

Introduction

Labichea Gaudich. ex DC. currently comprises 14 species, of which eight occur in Western Australia, one in the Northern Territory, and five in Queensland (Ross 1985). Two of the Western Australian species are only known from their type locations. The genus was revised by Ross (1985) and subsequently appeared in Volume 12 of the *Flora of Australia* (Ross 1998).

In recent years considerable survey effort has been focused on the Banded Iron Formation and greenstone ranges of the Yilgarn Craton (Gibson *et al.* 2007). This has resulted in the recognition and description of 21 taxa restricted to, or with their distributions centred on, these ranges (Wege *et al.* 2007). A new species of *Labichea* was found in the most recent of these surveys in the northern Forrestania Greenstone Belt near Mt Holland along with two other apparently undescribed taxa (Thompson & Allen, in review). The *Labichea* collections from this area are unifoliolate and have clearly differentiated wing, standard and keel petals, unlike the previously described species.

Taxonomy

Labichea rossii N.Gibson, *sp. nov.*

Species nova *L. punctata* Benth. affinis, sed floribus brevioribus et petalis dissimilis et ovario sericeis absentibus differt.

Typus: vicinity of Mt Holland, Western Australia [precise locality withheld for conservation reasons], 30 September 2010, *N. Gibson* 4686 & *E.M. Sandiford* (*holo*: PERTH 08259712; *iso*: BRI, CANB, MEL).

Labichea sp. Mt. Holland (W.A. Thompson & J. Allen 949), Western Australian Herbarium, in *Florabase*, http://florabase.dec.wa.gov.au [accessed August 2011].

Subshrub to 40 cm high, stems sparingly branched, semi-erect, clothed with appressed uncinate hairs and with occasional longer spreading hairs. *Leaves* unifoliolate, lamina narrowly elliptic, 25–35(–45) mm long, 5–7 mm wide, pungent apically, reticulate, with scattered tubercular-based uncinate hairs above, and with scattered appressed uncinate hairs below especially on midrib and leaf margins; petiole to 1 mm long, finely sulcate adaxially. *Stipules* narrowly triangular or subulate, 1.5–2.5 × 0.6–1 mm, glabrous, caducous. *Inflorescence* a 3–5-flowered raceme, much shorter than the subtending leaf; bracts ovate, (2.5–)3–4.5 × 2–2.5 mm, caducous. *Pedicels* 2–3 mm long, densely clothed with uncinated hairs. *Sepals* 5, becoming reflexed, the three outer ones 4–5 × 1.5–2 mm, acute apically, slightly cucullata, sparingly to densely clothed with uncinate hairs, the two inner sepals slightly shorter, almost glabrous with obtuse apex. *Petals* 4, yellow, dissimilar, wing petals 4–5 × 3–4 mm, standard 2.5–3 × 1.8–2 mm, keel 2.5–2.8 × 0.7–1 mm. *Stamens* 2, ± equal in length; filaments 0.3–0.5 mm long; anthers 2.8–3.5 mm long. *Ovary* 1–1.8 mm long, with a moderate to dense cover of uncinate hairs. *Style* 1.5–2.5 mm long. *Pods* not seen.

Other specimens examined. WESTERN AUSTRALIA: [precise locality withheld for conservation reasons] Forrestania Greenstone Belt (Mt Holland area), 4 Oct. 2009, *W.A. Thompson & J. Allen* 949 (PERTH).

Distribution. Currently only known from one small ironstone ridge, less than one hectare in area, near Mt Holland (Figure 1).

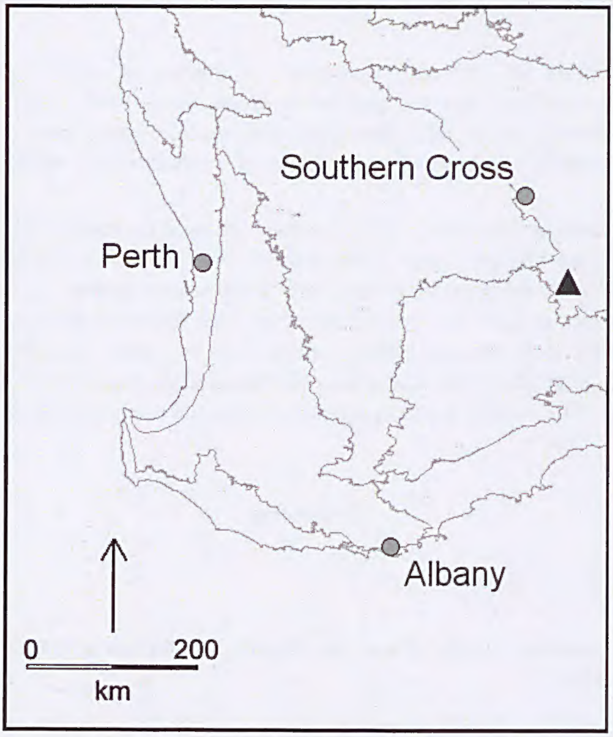


Figure 1. Distribution of *Labichea rossii* (▲) in south-west Western Australia. IBRA Bioregion boundaries (Department of the Environment, Water, Heritage and the Arts 2008) are shown in grey.

Habitat. The type location is on a small ironstone ridge which is dominated by an *Allocasuarina*-Proteaceae-Myrtaceae shrubland with occasional emergent eucalypts. *Labichea rossii* grows out of cracks in the massive outcropping banded ironstone, often in the shade of larger shrubs (Figure 2). The characteristic associated species include *Eucalyptus horistes, Allocasuarina acutivalvis* subsp. *acutivalvis, A. campestris, Banksia purdieana, Calothamnus quadrifidus* subsp. *seminudus, Hakea subsulcata, Melaleuca cordata,* and *Hibbertia exasperata.*

Phenology. Flowers in late September and early October.

Conservation status. *Labichea rossii* was recently listed as Priority One under the Department of Environment and Conservation (DEC) Conservation Codes for the Western Australian Flora. It is only known from the type location where it is locally common. The population is estimated to comprise approximately 100 plants. Despite extensive fieldwork being undertaken in the area over a two week period, no further populations were located. The two closest outcrops of Banded Iron Formation occur on Mt Holland and North Ironcap. No *Labichea* was found on Mt Holland while *Labichea stellata* J.H.Ross was found in similar habitats on North Ironcap. Both of these outcrops are less than 5 km from the *L. rossii* site.

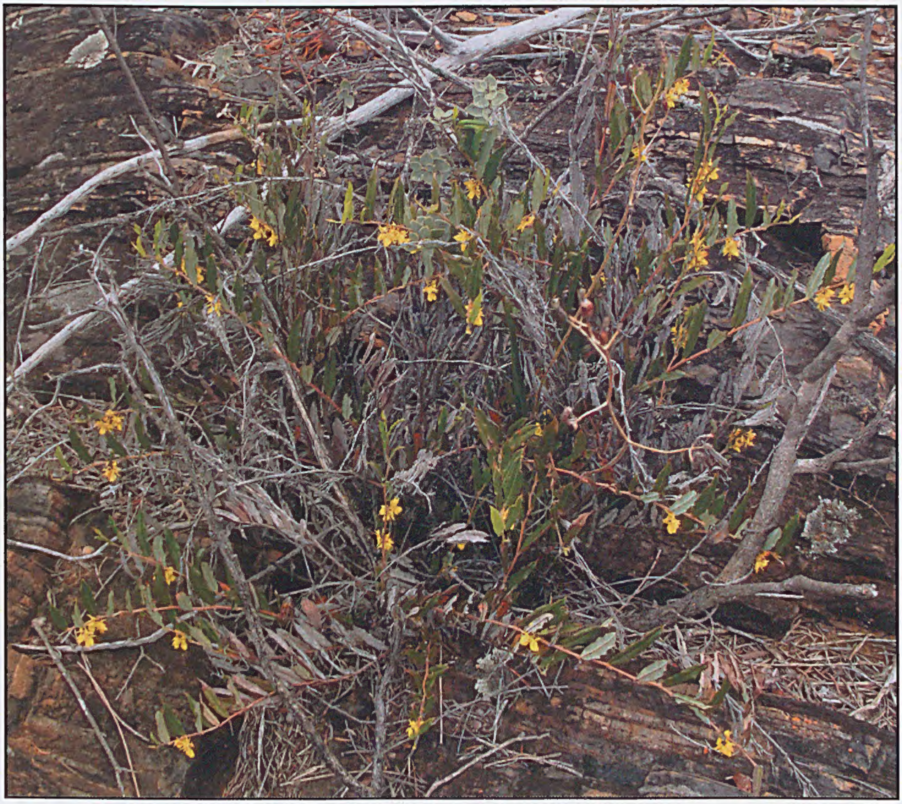


Figure 2. *Labichea rossii* growing out of cracks in massive ironstone on a small Banded Iron Formation ridge near Mount Holland. The dying back of some of the branches is probably due to the below average winter rainfall in 2010.

Etymology. Named in honour of Jim Ross, the recently retired head of the National Herbarium of Victoria (MEL), who has made a significant contribution to our understanding of the Fabaceae in Western Australia and who offered his unfailing assistance to Western Australian botanists during his stewardship at MEL.

Affinities and notes. *Labichea rossii* belongs to the small group of four taxa (*L. punctata* Benth., *L. rupestris* Benth., *L. digitata* Benth., and *L. stellata*) that possess equal anthers. It shows some affinities to the other unifoliolate taxon in this group *L. punctata,* which Ross (1985) considered to occupy an isolated position in the genus. However, *L. rossii* is easily separated from *L. punctata* by its smaller inflorescence and flowers, the lack of a silky indumentum on its ovary and its clearly differentiated wing, standard and keel petals (Figure 3). The unequal petals are more reminiscent of subfamily Faboideae than subfamily Caesalpinioideae and were consistent in all material studied. Of the 14 other species only the 5-foliolate *L. stellata* is reported as having unequal petals (Ross 1985). Some collections in PERTH of *L. stellata* (e.g. *P.S. Short* 1700a, 1700b*; N. Gibson & K. Brown* 3737) exhibit clearly differentiated petals similar to those of *L. rossii* while other collections have largely undifferentiated petals (e.g. *R.D. Royce s.n.* 8 Oct. 1965). All collections of *L. stellata* from the Mt Holland area have markedly dissimilar petals but this form is not restricted to this area. *Labichea rossii* is clearly differentiated from *L. stellata* by its unifoliolate leaves, shorter status (to 40 cm), lack of spreading hairs on young branchlets, and by its racemes being shorter than the subtending leaf.

Labichea rossii, *L. deserticola* J.H.Ross and *L. obtrullata* J.H.Ross have the most restricted distributions reported for the genus with *L. deserticola* (currently listed as Priority One, Smith 2010) only known from the type collection of Helms collected in 1891 from the Great Victoria Desert, and *L. obtrullata* (also listed as Priority One, Smith 2010) only known from two collections on Gabyon Station near Yalgoo made in 1962 and 1963 (Ross 1985, 1998). All three taxa urgently need further survey work to accurately determine their conservation status.

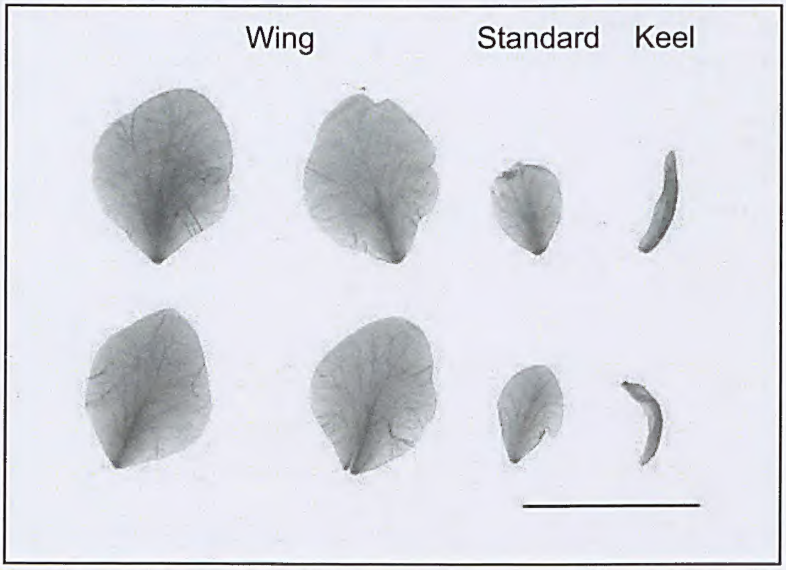


Figure 3. Dissected flowers of *Labichea rossii* showing clearly differentiated wing, standard and keel petals which are unusual in this subfamily (both from *N. Gibson* 4686 & *E.M. Sandiford*). Scale bar 5 mm.

Acknowledgments

I would like to acknowledge Wendy Thompson and Jessica Allen for bringing this species to my attention and Jim Ross for his comments on their collection. I also thank Paul Wilson who kindly corrected the Latin diagnosis and Kelly Shepherd for her skill in image processing.

References

Department of the Environment, Water, Heritage and the Arts (2008). *Interim Biogeographic Regionalisation for Australia (IBRA), Version 6.1.* http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html [accessed 8 May 2008]

Gibson, N., Coates, D.J., Thiele, K.R. (2007). Taxonomic research and the conservation status of flora in the Yilgarn banded iron formation ranges. *Nuytsia* 17: 1–12.

Ross, J.H. (1985). A revision of the genus *Labichea* Gaudich. ex DC. (Caesalpiniaceae). *Muelleria* 6: 23–49.

Ross, J.H. (1998). *Labichea. In*: *Flora of Australia.* Vol. 12, pp. 146–157. (CSIRO Publishing: Collingwood. Vic.)

Smith, M.G. (2010). *Declared Rare and Priority Flora List for Western Australia.* (Department of Environment and Conservation: Kensington, Kensington, WA.)

Thompson, W.A. & Allen, J. (in review) *Flora and vegetation of greenstone formations of the Yilgarn Craton*: *the northern Forrestania Greenstone Belt* [*Mt. Holland area*].

Wege, J.A., Shepherd, K.A. & Butcher, R. (2007). Preface. *Nuytsia* 17.

A new and rare species of *Ptilotus* (Amaranthaceae) from a suburban wetland of the eastern Swan Coastal Plain, Western Australia

Robert W. Davis and Catherine Tauss[1]

Western Australian Herbarium, Department of Environment and Conservation
Locked Bag 104, Bentley Delivery Centre, Western Australia, 6983
[1]Corresponding author, email: cate@iinet.net.au

Abstract

Davis, R.W. & Tauss, C. A new and rare species of *Ptilotus* (Amaranthaceae) from a suburban wetland of the eastern Swan Coastal Plain, Western Australia. *Nuytsia* 21(3): 97–102. *Ptilotus christineae* R.W.Davis & Tauss, currently known from only one small population in the Greater Brixton Street Wetlands, about 14 km from the centre of the city of Perth, is described and illustrated. A key to *Ptilotus* R.Br. of the Swan Coastal Plain Biogeographical Region is provided.

Introduction

The Eremaean Botanical Province of Western Australia is the centre of diversity for *Ptilotus* R.Br., a large and almost exclusively Australian genus (Townsend 1993; Western Australian Herbarium 1998–). Only thirteen *Ptilotus* taxa (about 10% of those known from Western Australia) occur in the Swan Coastal Plain Biogeographical Region (SCP; Department of Environment, Water, Heritage and the Arts 2008). Two of the SCP taxa, *Ptilotus christineae* R.W.Davis & Tauss, described herein, and *P. sericostachyus* subsp. *roseus* (Moq.) Benl, are endemic to this region; both are helophytes that have only been recorded from the fragmented remnants of the native vegetation on the eastern side of the plain. *Ptilotus sericostachyus* subsp. *roseus* has not been collected since 1906 and is likely to be extinct.

The diminutive *Ptilotus christineae* was first recognized as a new species by the second author in 2010 during a flora and vegetation survey of the Greater Brixton Street Wetlands (GBSW) that was conducted for the V & C Semeniuk Research Group. The GBSW comprise about 120 ha of remnant native vegetation of the lower catchment of the Yule Brook in the Perth suburbs of Kenwick and Wattle Grove; they are part of a gently sloping alluvial fan formation that extends from the foothills of the Darling Range to the Canning River. The complex stratigraphy and hydrology of this area manifests as a very diverse array of fine-scale plant habitats (V & C Semeniuk Research Group 2001). The GBSW are renowned as one of the most floristically-rich areas of the SCP and they have been formally recognized as Bush Forever Site 387 (Government of Western Australia 2000). There are at least five other *Ptilotus* taxa (*P. declinatus* Nees, *P. drummondii* (Moq.) F.Muell., *P. esquamatus* (Benth.) F.Muell., *P. manglesii* (Lindl.) F.Muell. and *P. stirlingii* (Lindl.) F.Muell. subsp. *stirlingii*) that have been previously recorded in the GBSW (Keighery & Keighery 2000).

Apart from the GBSW, most of the alluvial soils of the lower catchment of the Yule Brook were cleared of native vegetation many years ago for farming. Despite the proximity of Kenwick to the city, the seasonal waterlogging or inundation of much of this area previously rendered it uneconomical for urban development. Most of the land surrounding the GBSW is still currently zoned rural but it is under review with regard to re-zoning for industrial purposes. *Ptilotus christineae,* in common with much of the biota of the GBSW, is subject to threats from the surrounding land-uses and catchment management practices.

The discovery of *P. christineae* in the GBSW highlights the remarkable floral biodiversity that continues to persist, albeit precariously and sometimes overlooked, in the Perth Metropolitan Region of the SCP.

Taxonomy

Ptilotus christineae R.W.Davis & Tauss, *sp. nov.*

Ptiloto spathulato (R.Br.) Poir. affinis sed habitu rhizomato, spica leviter interrupta, et stamina 5 (quae in *P. spathulato* 3) statim dignoscenda.

Typus: Kenwick, Western Australia [precise locality withheld for conservation reasons], 23 October 2010, *C. Tauss, K.R. Thiele & R. Davis* CT 4136 (*holo*: PERTH 08247269, *iso*: CANB).

Ptilotus sp. Brixton (C. Tauss 4136), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au/ [accessed 4 May 2011].

Perennial herb to 8 cm high. *Rhizome* glabrous, 1–1.8 mm in diam., branched. *Shoots* annual, well-spaced. *Flowering stems* erect, one per shoot, with indistinct, pink ribs, glabrous or with sparse, white, sub-verticillate hairs. *Basal leaves* glossy, spathulate, 8–35 mm long, 2–10 mm wide, glabrous or with very sparse hairs. *Cauline leaves* alternate, oblanceolate to spathulate, 8–15 mm long, 2–5 mm wide, glabrous or with very sparse hairs. *Inflorescence* spiciform, terminal, ovate, maturing to loosely cylindrical, 30–45(–50) mm long, 18–25 mm diam. *Bracts* broadly obovate, 4.2–5 mm long, translucent; midrib pink-maroon with sparse, white, sub-verticillate hairs abaxially, becoming glabrous toward margins. *Bracteoles* similar to bracts, 5–6 mm long, apices slightly recurved. *Flowers* shortly pedicellate. *Outer tepals*, lanceolate, concave, 9–9.4 mm long; adaxially white with pink margins, glabrous except for proximal, long, white, contorted, nodose hairs; abaxially pink, densely hairy, the hairs long, white and sub-verticillate. *Inner tepals*, similar to outer tepals but narrower, 8.5–8.7 mm long; margins narrowly involute; apices glabrous, translucent. *Staminal cup* symmetrical, 0.8–1 mm long, glabrous. *Stamens* 5; filaments and anthers white, ageing to pinkish. *Style* ± straight, central to sub-central, white, 1.8–2 mm long. *Ovary* stipitate, glabrous, green. *Seed* not seen. (Figure 1)

Other specimens examined. WESTERN AUSTRALIA: [precise locality withheld for conservation reasons], Kenwick, 16 Oct. 2010, *C. Tauss* 4102 (PERTH 08273065).

Phenology. In 2010, the annual shoots of *Ptilotus christineae* and *P. manglesii*, which grow in the same habitat, became evident in late June. By the time the flowers of *P. christineae* reached anthesis in early October, most of the other annual and geophytic herbs at the site were desiccated and the soil

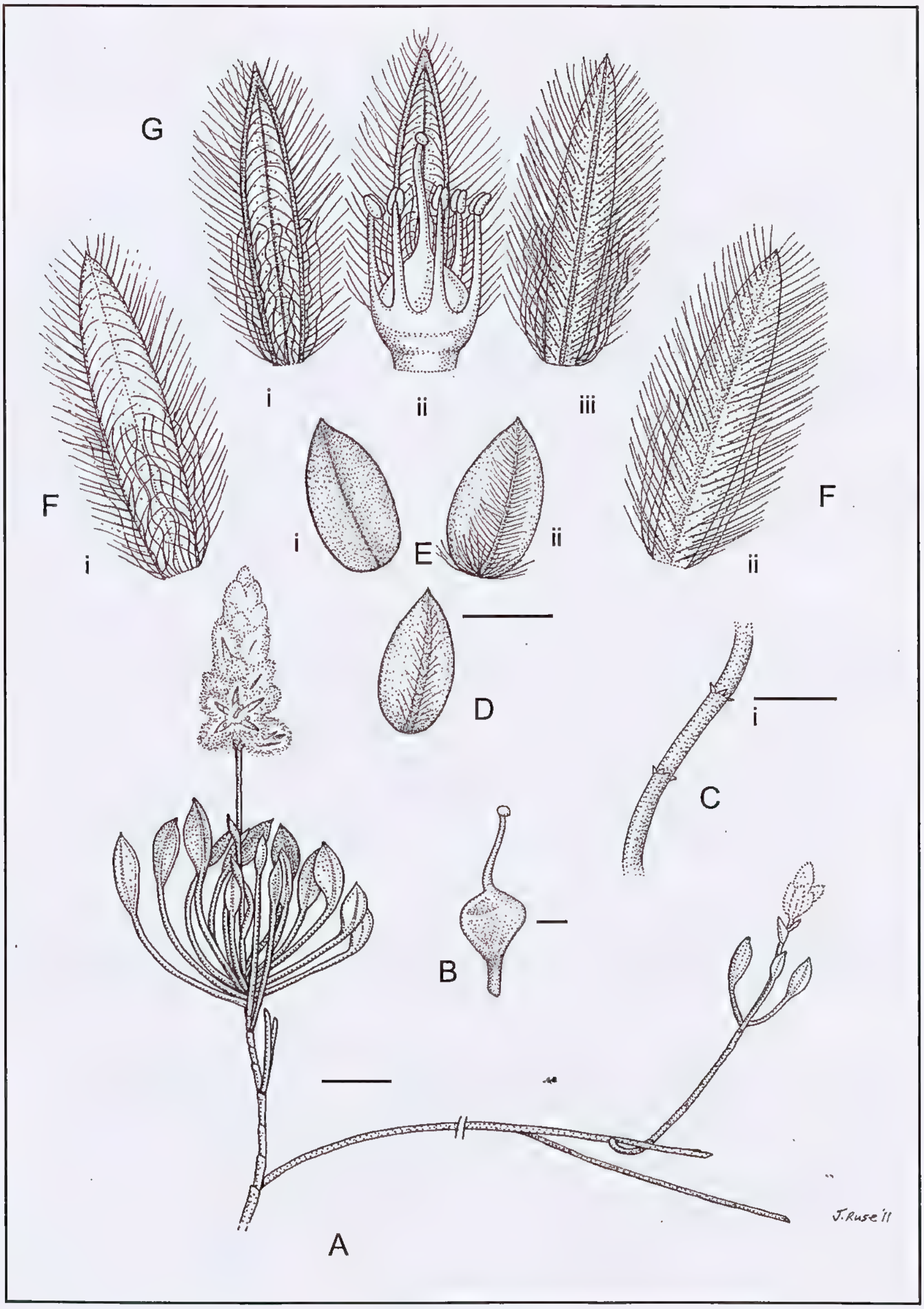


Figure 1. *Ptilotus christineae* (*C. Tauss, K.R. Thiele & R. Davis* CT4136). A – habit; B – gynoecium; C – subverticillate hairs; D – bract; E – bracteole, i) adaxial surface, ii) abaxial surface; F – outer tepals, i) adaxial surface, ii) abaxial surface; G. inner tepals, i) adaxial surface, ii) adaxial surface with stamens and ovary *in situ*, iii) abaxial surface. Scale bars: A = 20 mm; B = 1 mm; C = 0.05 mm; D–G = 2.5 mm.

surface was dry. *Ptilotus manglesii* commenced flowering at the end of October and for a short period, both *Ptilotus* were observed in full flower together.

Etymology. The specific epithet honours the contribution of Dr Christine A. Semeniuk to wetland science; her work also illuminates the study of wetland plant habitats.

Distribution and habitat. Ptilotus christineae is currently known from only one small population at the type location. The total area of occupancy of this species is estimated to be less than 0.2 ha.

Ptilotus christineae inhabits a seasonally inundated flat (floodplain) at an elevation of about 6.5 m above sea level. The site is underlain by pale grey, muddy-sand to sandy-mud alluvium (Guildford Formation) of the Pinjarra Plain (V & C Semeniuk Research Group 2001). The regional, unconfined, groundwater in most of this area of the GBSW is generally at about ground level in late winter. At a local scale, the hydrology and stratigraphy of the wetlands is complex with small, confined (artesian) aquifers and shallow aquitard layers of ferricrete or calcareous muds or clays that perch rainwater for varying lengths of time (V & C Semeniuk Research Group 2001). In 2010, despite record-breaking low rainfall in the region, the site inhabited by *P. christineae* was shallowly inundated for a short period in winter.

Ptilotus christineae was recorded in patchy *Melaleuca acutifolia* open scrub over *Verticordia plumosa* var. *brachyphylla* and *Hypocalymma angustifolium sens. lat.* open heath over *Meeboldina cana*–*Chorizandra enodis* open rushes and sedges and mid-dense, species-rich native annual herbs and geophytes. Common associates of this vegetation included *Acacia lasiocarpa* var. *lasiocarpa sens. strict.*, *Borya scirpoidea*, *Bulbine semibarbata*, *Burchardia multiflora*, *Centrolepis aristata*, *Diuris* aff. *laxiflora*, *Drosera heterophylla*, *D. menziesii* subsp. *menziesii*, *D. tubaestylis*, *Gahnia trifida*, *Hyalosperma cotula*, *Pheladenia deformis*, *Podolepis gracilis*, *Pogonolepis stricta*, *Ptilotus manglesii*, *Sowerbaea laxiflora*, *Stylidium divaricatum* and *Tribonanthes australis.* Naturalized alien taxa in this assemblage included *Heliophila pusilla*, *Romulea rosea* var. *communis* and *Sparaxis bulbifera.*

Threats. Ptilotus christineae is threatened by off-road vehicles, hydrological and climatic change, nutrient enrichment of groundwater, invasive naturalized alien plants (particularly *Sparaxis bulbifera*, *Morea flaccida* and *Hyparrhenia hirta*, which are prevalent in the area), rabbits and frequent fires.

The current municipal drainage scheme does not consider the environmental water requirements of the vegetation in the GBSW. Subsequent to the extensive vegetation clearing in the Yule Brook catchment and the resulting increase in the volume of runoff, the brook was excavated to mitigate the flooding of adjacent properties and to convey rainwater (part of which previously infiltrated into the groundwater in the GBSW) directly into the Canning River. The GBSW are thus no longer subject to natural, regular flooding and alluvial sediment supply from the Yule Brook. A number of other excavated drains, firebreaks and vehicle tracks in the area intersect some of the local, shallow aquifers and also contribute to the dewatering of the GBSW (V & C Semeniuk Research Group 2001). The adverse impact of these changes on the hydrological regime of the GBSW will be exacerbated by the trend towards a drier climate that is now evident in the SCP.

There is continuing uncertainty of the land tenure of many blocks in the GBSW and currently no overall plan to manage the wetlands, to ameliorate the impacts of the surrounding land uses on the native vegetation and to guide local planning authorities.

Conservation status. *Ptilotus christineae* is currently listed as a Priority One species under the Department of Environment and Conservation's Conservation Codes for Western Australian Flora (Smith 2010), as *Ptilotus* sp. Brixton (C. Tauss 4163). It is only known from one small population with a very small area of occupancy that is vulnerable to clearly demonstrable threats.

The Greater Brixton Street Wetlands and about 400 ha of the adjoining rural lands have been searched by the second author in several intensive, multi-season surveys (including Tauss & Weston 2010) and no other occurrences of *Ptilotus christineae* have been found. It is unlikely that other populations will be located in the SCP as the habitat of this species is scarce and has been thoroughly explored (Government of Western Australia 2000) due to its high conservation values.

Affinities. In a vegetative state, *Ptilotus christineae* bears a superficial resemblance to *Ptilotus spathulatus* (R.Br.) Poir. as both have fleshy, spathulate, basal leaves. However, there are clear floral, habit and distribution differences between the two species. *Ptilotus spathulatus* has three stamens and two staminodes, a broadly curved or sigmoid style that is eccentrically attached to the ovary and hairs that are mainly verticillate. In addition, *P. spathulatus* has a hard, woody, rootstock that produces several to many prostrate flowering stems on each plant, and a denser inflorescence than *P. christineae*. *Ptilotus spathulatus* is only known from well-drained sites in the semi-arid zone of the South West Botanical Province of Western Australia.

Ptilotus christineae is clearly distinguished from all congeners in the SCP by the combination of its slender rhizome, spathulate leaves, erect flowering shoot, five fertile stamens and wetland habitat.

Key to *Ptilotus* taxa of the Swan Coastal Plain Biogeographical Region

1. Plants with 5 fertile stamens
  2. Branches (or scape, in *P. christineae*) erect or arching
    3. Interstaminal lobes absent, leaves spathulate .... **P. christineae**
    3: Interstaminal lobes present, leaves narrow and linear .... **P. drummondii**
  2: Branches prostrate
    4. Inflorescences ovoid to globose, tepal indumentum sericeous .... **P. esquamatus**
    4: Inflorescences cylindrical, tepal indumentum woolly .... **P. humilis**
1: Plants with 2–4 fertile stamens
  5. Fertile stamens 2
    6. Staminal cup glabrous, style slightly curved .... **P. stirlingii** subsp. **stirlingii**
    6: Staminal cup hairy, style markedly falcate
      7. Bracteoles 5–6.5 mm long .... **P. sericostachyus** subsp. **sericostachyus**
      7: Bracteoles 7.5–8 mm long .... **P. sericostachyus** subsp. **roseus**
  5: Fertile stamens 3–4
    8. Outer tepals with sparse, short, stiff hairs
      9. Tepals 11–14 mm long, style 8–10 mm long .... **P. gaudichaudii** subsp. **gaudichaudii**
      9: Tepals 6–9 mm long, style 2–3 mm long .... **P. gaudichaudii** subsp. **eremita**

8: Outer tepals with dense, long, soft hairs

  10. Branches erect, inflorescences predominately white-green

    11. Inflorescences ovoid, hemispherical or orbicular, style 2.5–4.6 mm long .... **P. divaricatus**

    11: Inflorescences cylindrical, style 7–13 mm long .... **P. polystachyus**

  10: Branches prostrate, inflorescences predominantly pink-purple

    12. Basal leaves present, bracts brown, style more or less straight .... **P. manglesii**

    12: Basal leaves absent, bracts translucent, style markedly falcate .... **P. declinatus**

Acknowledgements

We thank Kevin Thiele and the staff of the Western Australian Herbarium for ongoing support and the use of *FloraBase* and the collections, Jill Ruse for the illustration, the referees for their helpful comments and Paul Wilson for the Latin diagnosis. Monocot-Dicot Botanical Research, Padbury funded the illustration and supported the contribution of time and other resources by C. Tauss to this publication.

References

Department of Environment, Water, Heritage and the Arts (2008). *Interim Biogeographic Regionalisation of Australia (IBRA) Version 6.1.* http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html [accessed June 28 2011].

Government of Western Australia (2000). *Bush forever: keeping the bush in the city.* (Dept. of Environmental Protection: Perth.)

Keighery, G.J. & Keighery, B.J. (2000). The flora of the Greater Brixton Street Wetlands. *In*: Marshall, J. (ed.). *The Brixton Street Wetlands: management guidelines, natural history and research.* p. 15–34. Unpublished report for the Friends of Brixton Street Wetlands Inc. Kenwick, Western Australia.

Smith, M.G. (2010). *Declared Rare and Priority Flora List for Western Australia.* (Department of Environment and Conservation: Kensington, WA.)

Tauss, C. & Weston, A.W. (2010). *The flora, vegetation and wetlands of the Maddington-Kenwick Strategic Employment Area. A survey of rural lands in the vicinity of the Greater Brixton Street Wetlands.* Unpublished report to the City of Gosnells, Western Australia.

Townsend, C.C. (1993). Amaranthaceae. *In*: Kubitzki, K. (ed.). *The families and genera of vascular plants.* Vol. 2, 86–87. (Springer-Verlag: Berlin.)

V & C Semeniuk Research Group (2001). *Hydrological study of the Greater Brixton Street Wetlands.* Unpublished report to the Friends of Brixton St Inc. Kenwick, Western Australia.

Western Australian Herbarium (1998–). *FloraBase–the Western Australian Flora.* Department of Environment and Conservation. http://florabase.dec.wa.gov.au/ [accessed June 28 2011].

An assessment of some infraspecific taxa in *Ptilotus* (Amaranthaceae) from Western Australia

R.W. Davis

Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, WA 6983

Abstract

An assessment of some infraspecific taxa in *Ptilotus* (Amaranthaceae) from Western Australia. *Nuystia* 21(3): 103–106 (2011). This paper deals with three infraspecific taxa in *Ptilotus* R.Br. that do not warrant recognition: *Ptilotus appendiculatus* Benl var. *minor* Benl, *Ptilotus divaricatus* (Gaudich.) F.Muell. var. *rubescens* Benl and *Ptilotus lanatus* Cunn. ex Moq. var. *glabrobracteatus* Benl.

Introduction

This paper is a continuation of work begun by Davis (2009) to assess the validity of infraspecific taxa within the genus *Ptilotus* R.Br. in preparation for a *Flora of Australia* treatment of the Amaranthaceae.

Gerhard Benl (1910-2001) was one of the most prolific authors on the genus *Ptilotus* (Benl 1959, 1980, 1983, 1994). However, in the 17 years since Benl (1994) described his last new taxon in *Ptilotus*, there has been a substantial growth in collections, allowing a reappraisal of some of his taxa. Benl's taxonomy was detailed and he attempted to provide a taxonomic rank for many minor variants, even ones represent by only one or very few specimens. Bean (2008) noted that some of Benl's infraspecific taxa have proven of little or no taxonomic value after modern reappraisals.

The purpose of this paper is to reduce to synonymy infraspecific taxa that are now regarded as having no taxonomic merit.

Ptilotus appendiculatus Benl, *Muelleria* 1: 102 (1959). *Type*: Western Australia – Globe Hill Station, Ashburton River, 6 Oct. 1905 , *A. Morrison* 15098 (*holo*: K, image seen; *iso*: E).

Ptilotus appendiculatus var. *minor* Benl, *Nuytsia* 4: 267 (1983). *Type*: Boodardee, about 15 miles (24 km) W of Port Hedland, Western Australia, 9 Sept. 1969, *S.L. Everist* 9195 (*holo*: BRI!).

Benl erected var. *minor* on the basis of a single specimen, which diverged from var. *appendiculatus* in its 'much-branched habit, smaller spikes with narrower flowers and less conspicuous appendages of the outer tepals' (Benl 1983: 267). At the time the distance between the single collection of var. *minor* and the nearest var. *appendiculatus* was *c.* 350 kilometres. Benl noted that there appeared to be habitat differences between the two taxa, with var. *minor* occurring on a flood plain and var. *appendiculatus* apparently restricted to 'spinifex [*Triodia*] hills' (Benl 1983: 269). Benl described the ovary as 'almost glabrous' in var. *minor* and 'sparsely pilose at the summit' in var. *appendiculatus*. He also suggested that the two taxa differed in flower colour, noting that Everist (*in sched*., *S.L. Everist* 9195) had described the flowers of var. *minor* as 'white to pale ivory coloured' and that in collections of var. *appendiculatus* (e.g. *W.H. Butler s.n.*, 9 Aug. 1963) the tepals were 'tinged pink' (Benl 1983: 269). Despite these apparent differences, Benl noted that some collections of the typical form (e.g. *W.H. Butler s.n.*; *R. Pratt* 2/0199) had a 'branching pattern resembling that of var. *minor*' (Benl 1983: 269); on this basis he described the latter (var. *minor*) at varietal rank.

On examining the wider range of specimens now available at PERTH, branching habit varies continuously from little- to much-branched in *P. appendiculatus*. The type collection of var. *minor* is of a juvenile plant, and the tepals are fractionally smaller than in most specimens (10–10.9 mm long *cf* 11–13.4 mm long). Flower size in *Ptilotus* can be affected by both age of plants and seasonal factors: in drier seasons plants often produce smaller flowers. The outer tepal appendages, although slightly smaller in var. *minor*, are consistent in shape between both taxa.

When var. *minor* was described there was a significant geographical disjunction (*c*. 350 km) between its type locality and the nearest specimens of the typical variety. Since then, further collecting has partially filled the gap, which is now reduced to *c*. 200 kilometres. *Ptilotus appendiculatus* is now known to occur in a variety of habitats throughout the south-west region of the Pilbara including flood plains, colluvial flats and stony hills.

The type of var. *minor* has a glabrous ovary; in specimens of var. *appendiculatus* the ovary ranged from densely pilose to sparsely pilose along the ovary summit, to glabrous. Ovary indumentum is not an adequate discriminating character in *Ptilotus appendiculatus*.

Benl's comments regarding flower colour are problematic for two reasons; firstly, Everist may have been referring to spike colour in his description of var. *minor* while Butler was referring to individual tepals in var. *appendiculatus*. Flowering spikes in *P. appendiculatus* have a lighter overall appearance because of the dense tepal indumentum. The second problem is that individual collector's interpretations of flower colour are likely to vary.

Selected specimens examined. WESTERN AUSTRALIA: 11 km S of Mount Delphine, West Hamersley Range, 27 July 1999, *B. Backhouse, D. Edinger & G. Marsh* BEM 151 (PERTH); 6 miles N of Cane River, 9 Aug. 1963, *W.H. Butler s.n.* (PERTH); Barrow Island, 6 Aug. 1973 *W.H. Butler* 178 (PERTH); *c*. 20 km E of Pannawonica, Pilbara, M5-8, Jul. 1999, *P. Ellery s.n.* (PERTH); Bullara turnoff, *c*. 1 mile E of Yanrey Homestead, 29 Aug. 1960, *A.S. George* 1169 (PERTH); near Quarry Hill, *c*. 125 km W of Tom Price, 8 Aug. 1984, *K.R. Newbey* 10799 (CANB, K, PERTH); 60 miles S of Onslow, 11 Sep. 1961, *F. Smith s.n.* (PERTH); 14.5 km SSW of Panawonnica and 300 m W of Jimmawurrada Creek, 13 Aug. 1991, *M.E. Trudgen & S. Maley* MET 10279 (CANB, PERTH,); North West Coastal Highway, 26 km west of Barradale, 30 Aug. 2003, *J.E. Wajon* 883 (PERTH).

Ptilotus divaricatus (Gaudich.) F.Muell., *Fragm*. 6: 229 (1868). *Trichinium divaricatum* Gaudich. in L. de Freycinet, *Voy. Uranie Bot*. 445 (1829). *Type*: Shark Bay, Western Australia, 1817–1820, *C. Gaudichaud* 71 (*holo*: P, *n.v.*; *iso*: BM, *n.v.*, G, *n.v.*).

Trichinium striatum Moq. ex Benth., *Fl. Austral.* 5: 233 (1870); *Ptilotus striatus* (Moq. ex Benth.) F.Muell., *Syst. Census Austral. Pl.* 1: 28 (1882). *Type*: Swan River, Western Australia, 1843, *J. Drummond* 430; Port Gregory [Western Australia], *A.F. Oldfield s.n.*, (*n.v.*); Dirk Hartog Is. [Western Australia], *W.G. Milne s.n.*, (*n.v.*)

Ptilotus divaricatus (Gaudich.) F.Muell. var. *rubescens* Benl, *Nuytsia* 3: 169 (1980). *Type*: *c.*1 km NE of Bore Camp, Dirk Hartog Island, Western Australia, 6 Sep. 1972, *A.S. George* 11578 (*holo*: PERTH 1555057!; *iso*: CANB).

Benl described *Ptilotus divaricatus* var. *rubescens* on the basis that it diverged from typical *P. divaricatus* in having 'red flowers' and 'the initial development of the inflorescence from cone-shaped, turning ovoid or sub-spherical' (Benl 1980: 169). In the label notes accompanying the specimen, the collector noted that the flowers were pink and that white-flowering plants (i.e. typical *P. divaricatus*) were not known on Dirk Hartog Island. Further collections lodged in PERTH indicate that in some populations (e.g. *A. Carr* 591) white- and pink-flowering plants grow in mixed stands, with all hues in between. Flower and inflorescence colour is a variable feature in many taxa of *Ptilotus*, both within and between populations. Assessment of a wide range of specimens shows that the development of flowering spikes in *P. divaricatus* is the same between white- and pink-flowering forms.

Selected specimens examined. WESTERN AUSTRALIA: between Tamala & Carrarang, 11 Oct. 1973, *J.S. Beard* 6808 (PERTH); Dongara, Irwin River Estuary Nature Walk Trail, Church Street, 17 Oct. 2000, *A. Carr* 566 (PERTH); near the monastery (Benedictine retreat) E side, road to monastery is N side Ocean Drive *c.* 2 km from town centre, 23 Nov. 2001, *A. Carr* 591 (PERTH); Urchin Point, Dirk Hartog Island, 8 Oct. 1997, *D.J. Edinger* 1250 (PERTH); Cape Range National Park, 8 Aug. 2006, *J. English* 0107 (PERTH); *c.* 48 km East of Mount Narryer, 14 Oct. 1998, *A.S. George* 17504 (PERTH); East Wallabi Island, Abrolhos Islands, 18 Nov. 1999, *J. Harvey s.n.* (PERTH); Peron Peninsula, 30 Apr. 1996, *G. Liddelow* SB 13 (PERTH); Shark Bay, 5 Oct. 1989, *M.E. Trudgen* 7448 (PERTH).

Ptilotus lanatus Cunn. ex Moq. in A.P. de Candolle, *Prodr.* 13(2): 281 (1849). *Trichinium lanatum* (Cunn. ex. Moq.) Druce, *Bot. Soc. Exch. Club Brit. Isles* 1916, 2nd Suppl. 651 (1917), *nom. illeg.*, *non* Lindl. (1838). *Type*: Swan Bay, N.W. Australia, 1835, *A. Cunningham s.n.* (*holo*: K, *n.v.*).

Trichinium cunninghamii Benth., *Fl. Austral.* 5: 238 (1870). *Ptilotus cunninghamii* (Benth.) F.Muell., *Pl. NW Australia* 7 (1887), *nom. illeg. Type*: Point Cunningham, Cygnet Bay, King Sound [Western Australia], 1822, *A. Cunningham* 153 (*holo*: BM, *n.v.*; *iso*: K, *n.v.*, MEL, *n.v.*).

Ptilotus lanatus Cunn. ex Moq. var. *glabrobracteatus* Benl, *Muelleria* 1: 107 (1959) *Type*: near King Sound, Western Australia, 1887, *W.W. Froggat* 15 (*holo*: MEL; *iso*: K, image seen, MEL, NSW).

In describing *Ptilotus lanatus* var. *glabrobracteatus*, Benl (1959) cited differences in the lengths of the bracts and bracteoles between var. *lanatus* (bracts to 2.3 mm long and bracteoles to 1.8 mm long) and var. *glabrobracteatus* (bracts to 3.5 mm long and bracteoles to 2mm long), as well as density of the indumentum on these floral parts. He noted at the time of publication that there were intermediates. On examining current PERTH collections there is an imperceptible gradation of indumentum density. In the specimens examined var. *lanatus* bracts ranged from 1.4–2.5 mm long and bracteoles 1.2–1.8 mm long; and in var. *glabrobracteatus* bracts ranged from 2–2.8 mm long and bracteoles 1.3–2 mm long. This shows a clear overlap of bract and bracteole lengths between the two taxa.

Selected specimens examined. WESTERN AUSTRALIA: Derby to Broome road, 20.3 km S (by road) of Derby, 19 Apr. 1985, *T.E.H. Aplin et al.* 76 (CANB, PERTH); 67 km NE of Lagrange Aboriginal Mission turnoff, Great Northern Highway, 1 Sep. 1978, *A.C. Beauglehole & E.G. Errey* B 59158 E 2858 (ACB, CANB, PERTH); One Arm Point, N Dampier Peninsula, Kimberley Coast, 28 Feb. 1989, *B.J. Carter* 356 (DNA, PERTH); 2 km on Beagle Bay Road from Broome, 12 May 1985, *P.R. Foulkes* 234 (PERTH); Broome, 2 May 1944, *C.A. Gardner* 7030 (CANB, PERTH); 5 km N of Point Coulomb, Dampierland, N of Broome, 17 Apr. 1977, *K.F. Kenneally* 5923 (CANB, K, MUN, PERTH); Camballin, May 1970, *Y. Power* 784 (L, PERTH); 66 miles E of Derby on road to Fitzroy Crossing, 10 Mar. 1967, *F. Power* 172 (PERTH) Mount Anderson Station, E of Derby, 3 Apr. 1964, *R.D. Royce* 8143 (CANB, PERTH); Lanlacatta Swamp on Camballin Station, Kimberley, 27 July 1997, *L. Wallis* LW 97A/120 19 Apr. 1985 (CANB, PERTH).

References

Bean, A.R. (2008). A synopsis of *Ptilotus* (Amaranthaceae) in eastern Australia. *Telopea* 12(2): 227–250.

Benl, G. (1959). New species and varieties of *Ptilotus* R.Br. (Amaranthaceae). *Muelleria* 1: 107.

Benl, G. (1980). Five new taxa of *Ptilotus* (Amaranthaceae) from Western Australia. *Nuytsia* 3: 169.

Benl, G. (1983). Taxonomic studies of *Ptilotus* R.Br. (Amaranthaceae) in Western Australia. *Nuytsia* 4: 269–270.

Benl, G. (1994). *Ptilotus mitchellii* (Amaranthaceae), a new species from the Pilbara region, Western Australia. *Sendtnera* 2: 25–30.

Davis, R.W. (2009). *Ptilotus luteolus*, a new combination in *Ptilotus* (Amaranthaceae). *Nuytsia* 19: 311–312.

A revision of *Dielsiodoxa* (Ericaceae: Styphelioideae: Oligarrheneae)

David E. Albrecht [1,3] and Michael Hislop [2]

[1]Alice Springs Herbarium, Department of Natural Resources, Environment, the Arts and Sport,
P.O. Box 1120, Alice Springs, NT 0871
[2]Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983.
[3]Corresponding author, email: dave.albrecht@nt.gov.au

Abstract

Albrecht, D. E. & Hislop, M. A revision of *Dielsiodoxa* (Ericaceae: Styphelioideae: Oligarrheneae). *Nuytsia* 21(3): 107–126 (2011). The genus *Dielsiodoxa* Albr., endemic to south-west Western Australia, is revised. The genus includes three previously named species, *D. leucantha* (E.Pritz.) Albr., *D. oligarrhenoides* (F.Muell.) Albr. and *D. tamariscina* (F.Muell.) Albr. A neotype is designated for the former species and a lectotype for the latter species. Three new taxa are described with accompanying scanned images: *D. lycopodioides* Albr., *D. propullulans* Albr. and *D. leucantha* subsp. *obtusa* Hislop & Albr. Descriptions, a distribution map and a key to all taxa are provided.

Introduction

In a recent paper Albrecht *et al.* (2010) erected a new genus *Dielsiodoxa* Albr. to accommodate three Western Australian species previously included within *Monotoca* R.Br. Based on morphological and molecular data they place *Dielsiodoxa* in the Oligarrheneae Crayn & Quinn as a sister to *Oligarrhena* R.Br. *Dielsiodoxa* is distinguished from *Oligarrhena* in having a 5-lobed corolla that is not laterally compressed (*cf.* consistently 4-lobed and laterally compressed in *Oligarrhena*), the lobes widely spreading at anthesis and lacking adaxial sub-marginal flaps (*cf.* lobes erect and with sub-marginal flaps in *Oligarrhena*), 5 stamens with the anthers attached near the midpoint to filaments that distinctly taper upwards (*cf.* 2 stamens with basifixed anthers and filaments not obviously tapering distally in *Oligarrhena*).

The three currently named species of *Dielsiodoxa* (*D. tamariscina*, *D. oligarrhenoides* and *D. leucantha*) were described prior to 1905 as species of *Monotoca*. The taxonomy of this group of species has not been reassessed in the past century and the only treatment that includes all three species (as *Monotoca*) is in *How to know Western Australian wildflowers* (Blackall & Grieve 1981). At least one name was misapplied in that treatment and in some instances the species concepts are too broad. We have endeavoured to address these issues in the revision of *Dielsiodoxa* presented here, which is based on morphological data.

Methods

Morphological observations are based on collections held at CANB, MEL, NSW, PERTH and UNSW. Measurements were made with a binocular light microscope fitted with an eyepiece graticule. Dried material was rehydrated by boiling prior to measuring. Leaf measurements were made on fully expanded flattened leaves. Leaf density was assessed on well developed vegetative shoot growth below the actively expanding distal section. The width of the raised leaf abscission scars on branchlets was measured on dried material. Leaf vein number was assessed along an imaginary transverse line at the midpoint of the leaf. Leaf venation pattern was examined on representative specimens after soaking in bleach for several days. Peduncle length was measured as the distance between the base of the peduncle and the lowermost bract (sterile or subtending a flower or fruit). Fruit length measurements excluded the persistent style. Stigma cleft depth was measured as the vertical distance between the base of the cleft and an imaginary transverse line between the tips of the two stigmatic lobes.

Leaves and, to a lesser extent, flowers readily dissociate from specimens when they dry, and herbarium specimens frequently have fragments loose in the specimen folders or in packets attached to the specimen. Caution was exercised when examining such fragments as it was not uncommon to find fragments of other *Dielsiodoxa* species mixed with the species mounted on the sheet.

Details of growth form, plant height, flower colour, habitat and locality were taken from the collector's notes recorded on the herbarium specimen label. Geocode data from PERTH specimens were plotted using DIVA-GIS Version 5.2.0.2 to produce the distribution maps.

Morphology

Growth patterns. The way in which new growth is initiated on branchlets appears to vary between species and certainly has value in distinguishing *D. propullulans* and *D. leucantha*. The axis of fertile branchlets usually continues vegetative growth beyond the uppermost fertile nodes in most taxa, as exemplified in *D. propullulans*. Additionally, some taxa may initiate new growth from within or rarely below the fertile section. *Dielsiodoxa leucantha* on the other hand appears to initiate new growth almost exclusively from below the fertile section of the branchlet or occasionally produces very short, abortive growth beyond the uppermost fertile nodes. Further field study is required to confirm observations made from herbarium material.

Leaves. All species have dense, sessile leaves with lunate, non-sheathing bases. Most species have helical leaf arrangement with the exception of *D. oligarrhenoides*, which is decussate. *D. oligarrhenoides* also differs from other species in having thick-textured leaves with the venation not visible on the abaxial side. The number of veins has some utility in distinguishing *D. lycopodioides*, as does the width of scars left on the branchlets when the leaves abscise. Leaf shape, width and length/width ratio are useful diagnostic characters for some taxa when used in combination with other characters.

Differences in leaf shape and dimensions were noted between seedling and adult plants of *D. propullulans*. For example the seedlings represented on *J.M. Powell* 2231A have long, lanceolate leaves (e.g. approximately 4.2 mm long x 0.9 mm wide), whereas adult specimens of this species have considerably shorter and broader leaves. The sample of specimens taken from immature plants is presently too small to assess the occurrence of leaf dimorphism in the genus more generally.

Flowers. Members of the genus have tiny bisexual flowers with a persistent 5-lobed corolla, upwardly tapering filaments, exserted anthers that are distinctly concave abaxially, free nectary scales and a 2-locular ovary and 2-lobed stigma. Relatively few floral characters have taxonomic value. Bracteole and sepal apex shape varies within the genus and can be useful for distinguishing some taxa when used with other characters. The presence of hairs on the external surface of the corolla is distinctive for *D. tamariscina*, all other taxa having glabrous corollas. Further field work is required to determine whether there are any consistent differences in fresh corolla colour between taxa. All taxa have ovaries (and fruit) with a smooth or weakly textured surface except for *D. lycopodioides*, which has a distinctly pustulate surface, albeit minutely so.

Fruit. All species of *Dielsiodoxa* have a dry, indehiscent fruit. Following Albrecht *et al.* (2010), we have used the general term 'nut' to describe this fruit type, though the more specific term achene (*sensu* Stuppy 2004) also appears to be applicable.

Susceptibility to disease

It is probable that all species of *Dielsiodoxa* are susceptible to *Phytophthora cinnamomi*. This is particularly problematic for the taxa that have a very restricted geographical range. Formal declaration as threatened flora may be appropriate for some taxa, and specific conservation measures may need to be implemented to ensure the long-term persistence of some populations. Species-specific information where available, is given under the species treatments.

Research needs

Albrecht *et al.* (2010) included limited *Dielsiodoxa* sequence data from two chloroplast encoded regions in their analyses. The *mat*K gene and the *atp*B-*rbc*L intergenic spacer were successfully sequenced for *D. leucantha* subsp. *obtusa* and *D. propullulans*, and the *mat*K gene for *D. leucantha* subsp. *leucantha*. Around the time that the Albrecht *et al.* paper was submitted for publication, material of *D. lycopodioides* and *D. tamariscina* was sent to Chris Quinn at NSW for extraction and sequencing, however sequences for these two species were not successfully obtained. Further attempts to gain sequence data for these two species would be worthwhile. In addition, a more comprehensive infraspecific sampling, utilising several DNA markers, would be particularly valuable in the case of *D. leucantha*, by far the most variable species recognised here and one with a remarkably disjunct distribution pattern.

To the best of our knowledge chromosome counts have never been obtained for any species of *Dielsiodoxa*. Chromosome numbers may provide valuable additional data for assessing relationships.

Limited fire response data is available for *Dielsiodoxa* species. *Dielsiodoxa lycopodioides* [as *Monotoca tamariscina*] is recorded as a strict seeder by Bell (1995). Other genera in the Oligarrheneae, namely the monotypic *Oligarrhena* and *Needhamiella* L. Watson are also strict seeders (Bell 1995; Bell *et al.* 1996). It is likely that all species of *Dielsiodoxa* are strict seeders, however this needs confirmation by field observations or anatomical sectioning.

Taxonomy

Dielsiodoxa Albr., *Austral. Syst. Bot.* 23: 329–330 (2010). *Type*: *Dielsiodoxa tamariscina* (F.Muell.) Albr.

Shrubs, mostly small; branchlets with an indumentum of short simple hairs, dense raised leaf abscission scars evident on older branchlets; winter-bud scales similar to leaves, non-deciduous. *Leaves* dense, short, helical or decussate, erect to appressed, readily abscising from dried specimens when touched; primary veins subparallel-palmate, unbranched or outermost branched only in the proximal half, often weakly visible on abaxial side; fibre bundles not touching adaxial or abaxial epidermis; abaxial surface lacking both papillae and ribbon wax; the outer wall of epidermal cells unlignified and unthickened, collapsing inwards on drying; minute hairs or teeth present somewhere on margins; apex straight to incurved, mucronulate or not; base non-sheathing, lunate in transverse section, lacking a petiole. *Inflorescences* axillary, few-flowered spikes lacking a rudiment, sometimes reduced to a single flower; spikes with a persistent bract subtending each flower, with or without sterile proximal bracts. *Flowers* bisexual, each subtended by a pair of persistent bracteoles; bracteoles glabrous except for minutely ciliolate margins, inserted immediately below the sepals. *Sepals* 5, persistent, glabrous except for minutely ciliolate margins; stomata absent on adaxial surface, absent or rare near the margins on abaxial surface. *Corolla* radially symmetrical, white to pale yellowish-green, persistent in fruit and turning brown in dried material, glabrous or rarely with sparse short hairs externally; tube shallowly U-shaped, equal to or shorter than corolla lobes, equal to or slightly exceeding the sepals; lobes typically 5 (rarely 4, 6 or 7-lobed), valvate in bud, midvein apparent, widely spreading at anthesis, lacking adaxial sub-marginal flaps. *Stamens* equal to corolla-lobe number; anthers tiny, bisporangiate, lacking appendages, strongly exserted from the corolla tube at maturity, attached to filament near the midpoint in a depression between the two microsporangia; filaments inserted in the throat of the corolla tube, distinctly longer than anthers, fine and distinctly tapering upwards. *Pollen* all shed as prolate pseudomonads; exine infolds with verrucate ornamentation. *Nectary scales* free, chartaceous. *Ovary* exceeding corolla tube, glabrous, smooth or textured with weakly to distinctly raised surface cells, 2(3)-locular with apical placentation, with a single ovule in each cell, ovoid to ellipsoid, ellipsoid in transverse section, tapering to a very short style; stigma 2(3)-lobed. *Fruit* a nut, apparently only one seed developing.

A genus of five species, all endemic to the south west botanical province of Western Australia.

Key to species of *Dielsiodoxa*

Notes on using key to species. Due to leaf curvature and the small size of fertile organs it is advisable to assess fresh or rehydrated material, preferably with a microscope fitted with an eyepiece graticule. Leaf width dimensions (including those used in l/w ratios) in the key are based on flattened mature (not seedling) leaves. Fruit length excludes the persistent style. Stigma cleft depth is the vertical distance between the base of the cleft and an imaginary line between the tips of the two stigmatic lobes.

1. Leaves usually decussate, occasionally helically arranged on some branchlets, thick-textured, venation not evident on abaxial side; apex of sepals obtuse .... **1. D. oligarrhenoides**

1: Leaves always helically arranged, thin-textured, venation at least weakly evident on abaxial side of some leaves; apex of sepals acute to obtuse **2**

2. Outer surface of corolla tube and lower part of corolla lobes with sparse short hairs; restricted to the Stirling Ranges .... **2. D. tamariscina**

2: Outer surface of corolla glabrous **3**

3. Ovary and fruit appearing densely and minutely pustulate due to distinctly raised surface cells; fruit 0.8–1 mm long; mature leaves subulate, lanceolate, ovate or rarely narrowly rhombic, 0.8–5.2 mm long, 0.3–1.1 mm wide, with l:w ratio of 2–13:1; 1–7 veins weakly visible on the abaxial leaf surface; raised leaf abscission scars 0.10–0.35 mm wide ....**3. D. lycopodioides**

3: Ovary and fruit smooth or with minute, dense, slightly raised, elongated surface cells; fruit 1.0–1.4 mm long; mature leaves ovate, depressed ovate to broadly rhombic-elliptic, 1.3–3.0 mm long, 0.9-2.5 mm wide, with l:w ratio of 0.7–2.1:1; 7–13 veins visible on the abaxial surface; raised leaf abscission scars (0.3–)0.4–0.7 mm wide 4

4. Axis of fertile branchlets usually continuing growth beyond the uppermost fertile nodes at anthesis, new growth sometimes also shooting from within fertile section of branchlet; leaves subtending inflorescences (from central part of fertile section of branchlet) broadly ovate, depressed ovate or rarely broadly rhombic-elliptic 1.5–2.2 mm wide, apex acute though sometimes appearing obtuse due to the abruptly incurved hidden tip that is at right angles to the axis of the leaf; shrub with comparatively few, mostly erect and straight branchlets; restricted to the Mt Ragged area ....**D. propullulans**

4: Axis of fertile branchlets usually not continuing growth beyond the uppermost fertile nodes at anthesis, if occasionally vegetative shoot beginning to grow through, then these very short and abortive, new growth more often shooting from below fertile section of branchlet; leaves subtending inflorescences (from central part of fertile section of branchlet) broadly rhombic-elliptic to broadly rhombic-ovate 0.6–1.5 mm wide, apex acute to acuminate, almost straight to distinctly incurved, the tip usually at an angle of 45 degrees or less relative to the leaf axis, very occasionally at right angles; west of Ravensthorpe 5

5. Bracteoles usually acute or subacute, rarely obtuse, ovate to broadly ovate (usually longer than wide) 0.4–0.7 (–0.8) mm long; sepals usually acute or subacute, occasionally obtuse 0.7–1.1 mm long; corolla tube (0.65–) 0.75–1.00 mm long; nectary scales variously shaped from oblong, lanceolate, oblanceolate to narrowly elliptic, (0.30–) 0.45–0.70 mm long; stigma cleft 0.05–0.18 mm deep ....**5a. D. leucantha** subsp. **leucantha**

5: Bracteoles usually obtuse, rarely subacute, broadly ovate to depressed-ovate (usually shorter than wide), 0.30–0.50 (–0.55) mm long; sepals usually obtuse, occasionally subacute, 0.50–0.75 (–0.85) mm long; corolla tube 0.5–0.8 mm long; nectary scales obovate to oblong-obovate, 0.25–0.40 (–0.55) mm long; stigma cleft 0.02–0.10 mm deep ....**5b. D. leucantha** subsp. **obtusa**

Descriptions

1. Dielsiodoxa oligarrhenoides (F.Muell.) Albr., *Austral. Syst. Bot.* 23: 330 (2010).

Monotoca oligarrhenoides F.Muell., *Fragm.* 9: 47 (1875). *Styphelia oligarrhenoides* (F.Muell.) F.Muell., *Syst. Census Austral. Pl.* 107 (1882). *Type*: Prope promontorium Cape Arid [Western Australia, *s. dat.*], *G. Maxwell s.n.* (*holo*: MEL 607256!).

Monotoca oligarrhenoides subsp. Gibson (R.D. Royce 3573) in G.Paczkowska & A.R.Chapman, *West. Austral. Fl: Descr. Cat.* 242 (2000), *p.p.*

Erect, spreading or sprawling densely branched, often compact *shrub* c. 0.15–0.50 (–1) m high. *Main stems and branches* grey to grey-brown, with longitudinally cracking persistent bark; *lateral branchlets* moderately fine, straight to somewhat curved, often entwined, grey-brown to brown, with an indumentum of variously orientated overlapping hairs 0.05–0.10 mm long, leaf abscission scars 0.3–0.8 mm wide. *Leaves* erect or ascending, decussate or occasionally helically arranged on some branchlets, densely imbricate with *c.* 20–48 leaves per cm, somewhat persistent in dried specimens but readily abscising when touched, rhombic to ovate, 0.7–2.0 mm long, 0.6–1.1 mm wide, thick-textured, rigid, strongly concave adaxially in proximal half and shallowly concave to more or less plane above, slightly keeled abaxially, adaxial and abaxial surfaces glabrous, concolorous, venation not visible; margins extremely narrow hyaline for the greater part, minutely ciliolate-serrulate, sometimes with longer hairs to 0.1 mm long on lower margins; apex not to slightly incurved, obtuse to subacute, lacking a mucro. *Inflorescences* (1)2 or 3(4)-flowered, borne on branchlets in a fertile section of variable length, the axis of fertile branchlets usually continuing growth beyond the uppermost fertile nodes at anthesis, new growth sometimes also shooting from within and rarely from below; *spike axis* 0.5–1.0 mm long including peduncle 0.3–0.6 mm long; *bracts* broadly rhomboid-ovate, often boat-shaped, 0.2–0.5 mm long, sterile proximal bracts absent or rarely 1 present; *bracteoles* broadly rhomboid-ovate, 0.3–0.5 mm long, 0.3–0.4 mm wide. *Sepals* ovate, 0.5–0.7 mm long, 0.3–0.5 mm wide, apex obtuse. *Corolla* (4)5(6)-lobed, mostly described as pale yellow in vivo at anthesis but label data also includes cream, greenish-white, yellow-green and green, presenting as rich brown post-anthesis in dried material, 1.5–1.9 mm long, glabrous; *tube* 0.6–0.8 mm long, mostly hyaline; *lobes* 0.8–1.2 mm long, 0.5–0.8 mm wide, acute to subacute. *Anthers* 0.2–0.3 mm long; free part of filaments 0.3–0.5 mm long. *Nectary scales* narrow elliptic to lanceolate, 0.3–0.7 mm long, 0.15–0.25 mm wide, acute to subacute. *Ovary* reddish (in rehydrated material), ovoid to ellipsoid, 0.8–1.1 mm long, 0.6–0.7 mm wide, textured by slightly raised elongated surface cells, 2-locular, style 0.1–0.2 mm long. *Fruit* dry and black in dried material, ovoid to ellipsoid, broadly ellipsoid to circular in cross-section, 1.0–1.3 mm long, 0.8–0.9 mm wide, smooth to finely textured by slightly raised elongated surface cells.

Specimens examined. WESTERN AUSTRALIA: 10 km due SSE of Mt Burdett, 2 Aug. 1983, *M.A. Burgman* 1635 *& S. McNee* (PERTH); 8.75 km due SE of Kau Rocks, 2.8 km SE of Mount Ney Road on Kau Rocks Road, 5 Sep. 1984, *M.A. Burgman & C. Layman* MAB 3531 (PERTH); Mallee Heath, 0.2 km SW of Tweedale Road on Muntz Road, Reserve 31799, Oct. 1984, *M.A. Burgman* 4300 (PERTH); 2 km W of Scaddan, 20 Aug. 1995, *R.J. Cranfield* 10202 (PERTH); N of Esperance, 4 Nov. 1901, *L. Diels* 5411 (PERTH); Lake Shaster Nature Reserve, off track running S from Springdale Road opposite Bedford Harbour Road, S of Munglinup, 26 Apr. 2008, *M. Hislop* 3761 (CANB, NSW, PERTH); 76.8 km E of Duke of Orleans Bay Road, 19 Sep. 1976, *R.J. Hnatiuk* 761032 (PERTH); *c.* 26 km SW of Israelite Bay and c. 160 km E of Esperance, 1 Oct. 1968, *E.N.S. Jackson* 1309 (AD, PERTH); 5 km E of Boyatup Hill, 11 Oct. 1983, *K. Newbey* 9796 (PERTH); Track to Point Malcolm, 4.5 km S of junction with Israelite Bay track, 29 Jul. 1986, *J.M. Powell* 2218 (DNA, NSW, PERTH); 2.6 km NW on Heywood Rd from junction with Karl Berg Rd, Esperance area, 5 Sep. 1986, *J.M. Powell* 2888 (NSW, PERTH, UNSW); 3 miles [*c.* 4.8 km] N of Gibson, 10 Aug. 1951, *R.D. Royce* 3573 (PERTH); 20 km E of Scaddan, 10 Sep. 1983, *P. van der Moezel* 290 (PERTH); 35 miles [*c.* 56.3 km] W of Esperance, 2 Sep. 1947, *J.H. Willis s.n.* (MEL); Approx. 48 km N of Esperance, 12 Sep. 1964, *P. Wilson* 3012 (AD, PERTH).

Distribution. Endemic to south-west Western Australia. Known from scattered locations between Scaddan and Point Malcolm, with an outlying western population near Lake Shaster (Figure 1).

Habitat. Available habitat information indicates that *D. oligarrhenoides* occurs on flat or slightly sloping terrain, sometimes near salt lakes, with deep, sandy soils, variously described as white, light grey or grey-brown, rarely with laterite present. *D. oligarrhenoides* occurs in heathland, tall scrub or very open shrub mallee. Associated dominants include species of *Banksia*, *Hakea*, *Grevillea*, *Melaleuca*, *Acacia* and mallee *Eucalyptus*.

Phenology. Flowering specimens have been collected between April and October.

Conservation status. A conservation nomination is presently considered unjustified, as a reasonable number of dispersed populations are known, including some with numerous plants. It occurs within Cape Arid National Park and other smaller conservation reserves.

Notes. Dielsiodoxa oligarrhenoides is readily distinguished by the presence of decussate leaves – a feature that is unique in the genus and is relatively uncommon in the Styphelioideae generally, where it is known in *Needhamiella* and some members of *Leucopogon* R. Br. *s.str.* and western '*Gynoconus*'. Although leaf venation is not apparent in *Dielsiodoxa oligarrhenoides*, cleared leaves show the typical *Dielsiodoxa* venation, though the veins (typically 5–7) are particularly broad in this species.

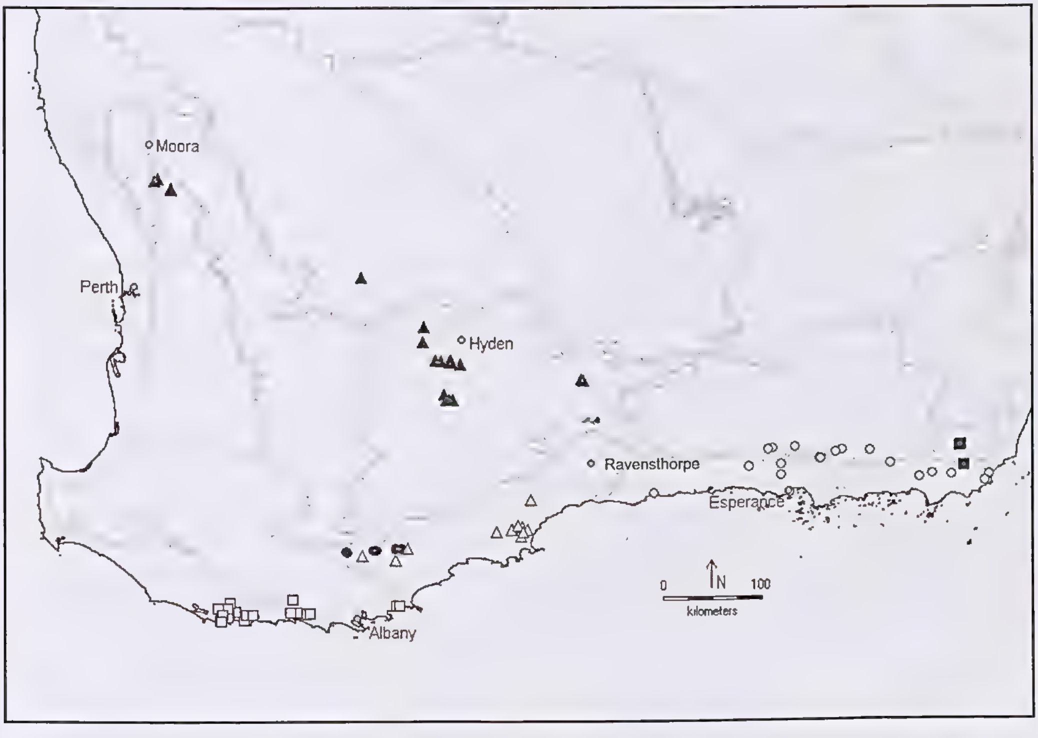


Figure 1. Distribution of *Dielsiodoxa leucantha* subsp. *leucantha* (▲), *Dielsiodoxa leucantha* subsp. *obtusa* (△), *Dielsiodoxa propullulans* (◘), *Dielsiodoxa lycopodioides* (□), *Dielsiodoxa tamariscina* (◉) and *Dielsiodoxa oligarrhenoides* (○) in Western Australia.

Blackall and Grieve (1981) misapplied the name *Monotoca oligarrhenoides*. The majority of specimens hitherto determined as *Monotoca oligarrhenoides* in Australian herbaria (probably largely based on Blackall and Grieve's concept) are *Dielsiodoxa propullulans*, and to a lesser extent *D. leucantha*, rather than *D. oligarrhenoides s.str*.

2. Dielsiodoxa tamariscina (F.Muell.) Albr., *Austral. Syst. Bot.* 23: 330 (2010). *Monotoca tamariscina* F.Muell., *Fragm.* 6: 79 (1867). *Styphelia minutiflora* F.Muell., *Fragm.* 11: 122 (1881). *Type*: In summis cacuminibus frigidiusculis montium Stirling's Ranges Australiae occidentalis inter rupes, [October 1867], *F. Mueller s.n.* (*lecto*, here designated: MEL 239718!; *isolecto*: MEL 239707!, MEL 239550!, MEL 2185965!, BM 001017993 digital image seen, K 000355600 digital image seen, K 000355602 digital image seen).

Illustration. W.E.Blackall & B.J.Grieve, *How to know W. Austral. Wildfl.* IIIB: 313 as *Monotoca tamariscina* (1981).

Erect to spreading densely branched *shrub c.* 0.1–0.5 (–1) m high. *Main stems and branches* grey to grey-brown, with longitudinally cracking persistent bark; *lateral branchlets* moderately fine, straight to somewhat curved, often entwined, grey-brown to brown, with an indumentum of spreading or variously orientated overlapping hairs 0.05–0.25 mm long, leaf abscission scars 0.2–0.4 mm wide. *Leaves* erect or ascending, sometimes appressed on main stems, helical, densely imbricate with *c.* 30–85 leaves per cm, variably persistent in dried specimens (sometimes only the terminal leaves retained), readily abscising when touched, lanceolate, narrowly elliptic, rhombic or ovate, 1.0–5.0 mm long, (0.3–)0.5–1.5 mm wide, those towards the distal ends of branchlets generally shorter and broader than those on the main stems, thin-textured, concave to plane adaxially in proximal half and more or less plane above, curved to saddle-shaped in longitudinal section, not keeled abaxially, adaxial and abaxial surfaces glabrous or with sparse short hairs, concolorous, 3–7 veins visible at least on the abaxial surface; margins sometimes with an extremely narrow hyaline fringe, minutely ciliolate-serrulate to ciliate with hairs to 0.4 mm long; apex not to strongly incurved, acute to acuminate, lacking a mucro. *Inflorescences* 1–3-flowered, borne on branchlets typically in a long fertile section, the axis of fertile branchlets usually continuing growth beyond the uppermost fertile nodes at anthesis, new growth sometimes also shooting from within fertile section of branchlet; *spike axis* 0.4–2.0 mm long including peduncle 0.1–0.6 mm long; *bracts* broadly rhomboid-ovate, often boat-shaped, 0.2–0.6 mm long, sterile proximal bracts absent or 1 or 2 present; *bracteoles* broadly rhomboid-ovate, 0.3–0.5 mm long, 0.2–0.4 mm wide. *Sepals* ovate, 0.3–0.8 mm long, 0.2–0.5 mm wide, apex acute or subacute. *Corolla* 5(–7)-lobed, mostly described as white in vivo at anthesis but label data also includes cream, creamy-yellow and greenish-white, presenting as brown post-anthesis in dried material, (1.0–)1.2–2.0 mm long, with short hairs to 0.1 mm long on the tube and at least on the proximal portion of external surface of the lobes; *tube* 0.4–1.0 mm long, mostly somewhat hyaline (most pronounced when fruiting); *lobes* 0.5–1.1 mm long, 0.2–0.5 mm wide, acute to subacute. *Anthers* 0.15–0.30 mm long; free part of filaments 0.3–0.6 mm long. *Nectary scales* narrow elliptic, lanceolate to narrowly oblong, 0.2–0.5 mm long, 0.05–0.20 mm wide, acute to obtuse. *Ovary* somewhat reddish (in rehydrated material), ovoid to ellipsoid, 0.6–1.2 mm long, 0.4–0.7 mm wide, textured by slightly raised longitudinally elongated surface cells, 2(3)-locular, style 0.1–0.2 mm long. *Fruit* dry and brownish-black in dried material, ovoid to ellipsoid, broadly ellipsoid to circular in cross-section, 1.1–1.3 mm long, 0.8-1 mm wide, finely textured as in ovary but not pustulate.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 6 Dec. 1994, *S. Barrett* 114 (PERTH); 7 Oct. 1994, *S. Barrett* 173 (PERTH); 7 Mar. 1995, *S. Barrett* 285 (PERTH); 23 Apr. 1923, *C.A. Gardner* 1427 (PERTH); 23 Apr. 1923, *C.A.Gardner* 1927 (PERTH);

11 Oct. 1928, *C.A. Gardner* 2195 (PERTH); Oct. 1928, *Gardner & Blackall s.n.* (PERTH); 12 Nov. 1961, *A.S. George* 3128 (PERTH); 7 May 1982, *S.D. Hopper* 2336 (CANB, K, PERTH); 24 Oct. 1985, *N. Hoyle* 1226 (PERTH); 11 May 1982, *G.J. Keighery* 4829 (PERTH); 2 Jul. 1957, *A.R. Main s.n.* (PERTH); 5 Oct. 1970, *B.R. Maslin* 1120 (PERTH); 25 Oct. 1985, *E. & S. Pignatti* 1551 (PERTH); 27 Oct. 1959, *R.D. Royce* 6059 (PERTH).

Distribution. Endemic to the Stirling Ranges in south-west Western Australia (Figure 1). All known populations are within Stirling Ranges National Park.

Habitat. Occurs in heathland or mallee heathland, mostly on quartzite mountain ranges. Most collections have been made from the higher parts of ranges (i.e. 1000 m altitude and above). Plants typically grow in rock crevices.

Phenology. Flowering specimens have been collected between October and December.

Conservation status. Recent field observations strongly indicate susceptibility to *Phytophthora cinnamomi* (Sarah Barrett pers. comm.). Given the active threat posed by *Phytophthora cinnamomi* and the small number of known populations, this species has been recently listed as Priority Two under the Department of Environment and Conservation (DEC) Conservation Codes for Western Australian Flora.

Typification. MEL 239718 has both flowers and fruit present and has been selected here as an appropriate lectotype.

There are some discrepancies between Mueller's protologue and the description presented here. Having examined all available material including a suite of specimens collected by Mueller (that includes the lectotype and isolectotypes), we believe that Mueller's protologue is in error with respect to the following features: presence of a narrow petiole, basally fused nectary scales and a 1-ovulate ovary.

Affinities. Blackall and Grieve (1981) had a broad species concept of *Monotoca tamariscina*, encompassing several taxa. Many specimens previously referred to *Monotoca tamariscina* are recognised in this treatment as *Dielsiodoxa lycopodioides*. Those specimens that are not *Dielsiodoxa lycopodioides* are either *D. tamariscina s. str.* or *D. leucantha* subsp. *obtusa*. *Dielsiodoxa tamariscina* differs from *D. lycopodioides* in having short hairs on the corolla tube and at least proximal part of corolla lobes externally (*cf.* glabrous in *D. lycopodioides*), non-pustulate ovary (*cf.* pustulate in *D. lycopodioides*) and larger fruits (1.1–1.3 mm long, *cf.* 0.8–1.0 mm long in *D. lycopodioides*).

Notes. Leaf shape, leaf indumentum and corolla size are rather variable in *D. tamariscina*.

Dielsiodoxa tamariscina occurs in the vicinity of *D. leucantha* subsp. *obtusa* and possibly *D. lycopodioides* (see notes under that species) in the central and eastern Stirling Ranges.

3. Dielsiodoxa lycopodioides Albr., *sp. nov.*

D. tamariscinae affinis sed corollis glabris, ovariis pustulatis, et fructibus parvioribus differt.

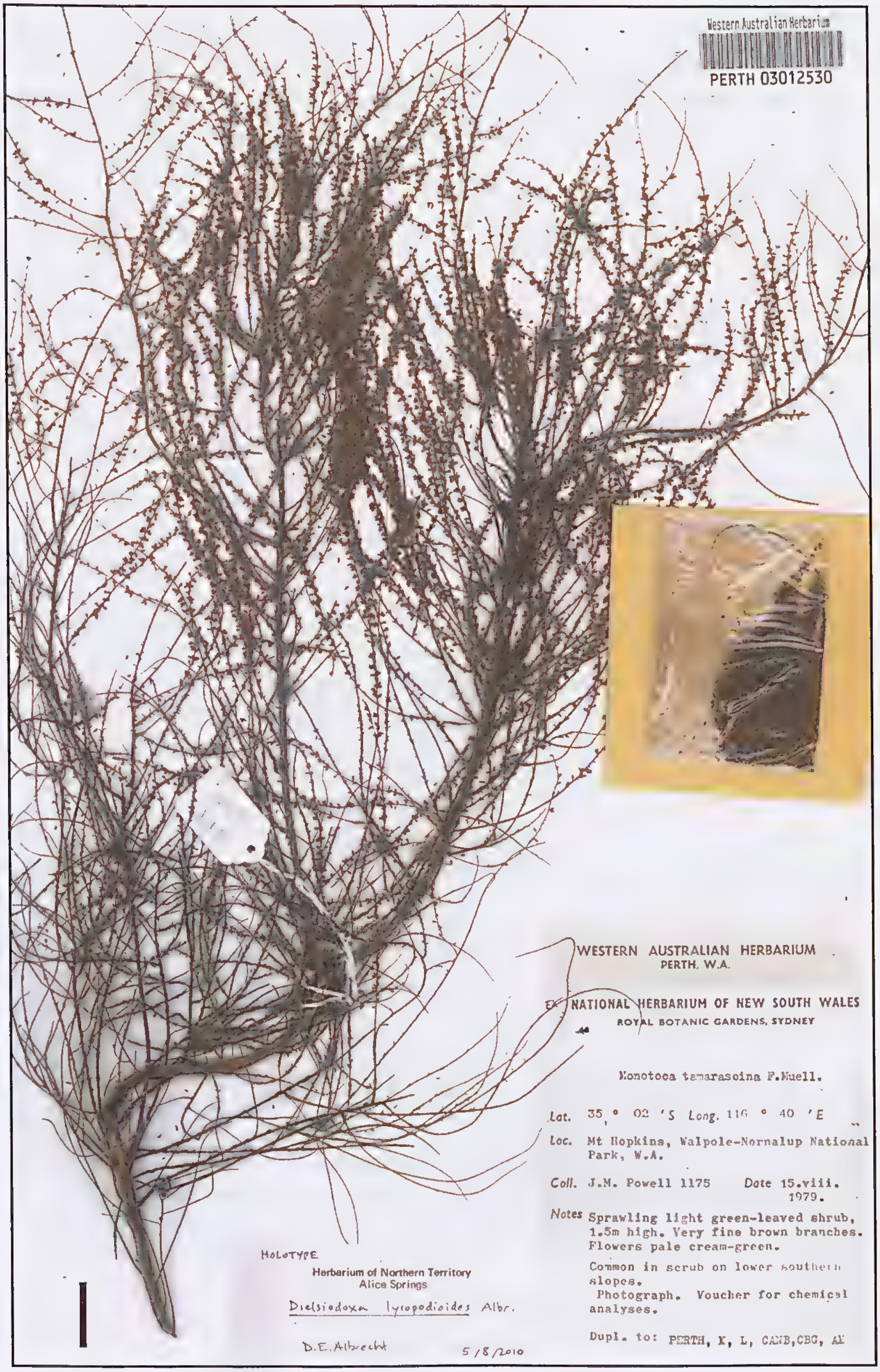
Typus: Mt Hopkins, Walpole-Nornalup National Park, Western Australia, 15 August 1979, *J.M. Powell* 1175 (*holo*: PERTH 03012530!; *iso*: AK *n.v.*, CANB!, CBG!, K *n.v.*, L *n.v.*, NSW!).

Monotoca sp. Walpole (B.J Lepschi 3666 & B.A.Fuhrer), Western Australian Herbarium, in *Florabase*, http://florabase.dec.wa.gov.au [accessed November 2010]; D.E.Albrecht, C.T.Owens, C.E.Weiller, & C.J.Quinn, *Austral. Syst. Bot.* 23: 320–332 (2010).

Illustration. J.Wheeler, N.G.Marchant & M.Lewington, *Fl. South West* 2: 606 (2002), as *Monotoca tamariscina.*

Erect to sprawling densely branched *shrub c.* 0.1–1.2(–2) m high. *Main stems and branches* grey-brown, with longitudinally cracking persistent bark; *lateral branchlets* fine, straight to somewhat curved, often entwined, grey-brown to brown, with an indumentum of mostly spreading hairs 0.05–0.10(–0.20) mm long, leaf abscission scars 0.10–0.35 mm wide. *Leaves* erect or ascending, sometimes appressed on main stems, helical, densely imbricate with *c.* 30–70 leaves per cm, typically few persisting in dried specimens (sometimes only the terminal leaves retained), readily abscising when touched, subulate, lanceolate, ovate or rarely narrowly rhombic, 0.8–5.2 mm long, 0.3–1.1 mm wide, (current seasons leaves with l:w ratio of 2–13:1) those towards the distal ends of branchlets generally shorter and broader than those on the main stems, thin-textured, concave to plane adaxially in proximal half and more or less plane above, curved to saddle-shaped in longitudinal section, not keeled abaxially, adaxial and abaxial surfaces glabrous or occasionally scabridulous on the adaxial surface, concolorous, 1–7 veins weakly visible at least on the abaxial surface; margins sometimes with an extremely narrow hyaline fringe, minutely ciliolate-serrulate with hairs to *c.* 0.2 mm long; apex incurved or straight, narrowly acute to acuminate, mucronulate or occasionally lacking a mucro. *Inflorescences* 1–3(4)-flowered, borne predominantly along the length of fine lateral branchlets, the axis of fertile branchlets often determinate but sometimes the upper ones continuing growth beyond the uppermost fertile nodes at anthesis, new vegetative growth apparently also shooting from upper axils of main stems; *spike axis* 0.4–2.0 mm long including peduncle 0.1–0.8 mm long; *bracts* broadly ovate to rhomboid-ovate, often boat-shaped, 0.2–0.5 mm long, sterile proximal bracts absent or 1–5 present; *bracteoles* broadly rhomboid-ovate, 0.25–0.40 mm long, 0.2–0.4 mm wide. *Sepals* ovate to ovate-elliptic, 0.4–0.8 mm long, 0.2–0.4 mm wide, apex acute. *Corolla* (4)5-lobed, apparently white, pale greenish-white or pale yellowish-green in vivo at anthesis, presenting as brownish post-anthesis in dried material, 1.0–1.5 mm long, glabrous; *tube* 0.5–0.7 mm long, mostly hyaline (most pronounced when fruiting); *lobes* 0.6–1 mm long, 0.3–0.5 mm wide, acute to subacute. *Anthers* 0.15–0.30 mm long; free part of filaments 0.25–0.45 mm long. *Nectary scales* narrow elliptic, lanceolate to narrowly oblong, 0.3–0.5 mm long, 0.05–0.10 mm wide, acute to obtuse. *Ovary* somewhat reddish (in rehydrated material), ovoid to ellipsoid, 0.6–0.8 mm long, 0.4–0.5 mm wide, minutely pustulate, 2-locular, style 0.1–0.2 mm long. *Fruit* dry and brownish-black in dried material, ovoid to broadly ellipsoid-globose, broadly ellipsoid to circular in cross-section, 0.8–1.0 mm long, 0.6–0.8 mm wide, minutely pustulate. (Figure 2)

Selected specimens examined. WESTERN AUSTRALIA: Walpole-Nornalup National Park, 17 Dec. 1985, *A.R. Annels s.n.* (PERTH); Between Albany and Denmark, *c.* 1.25 km W of Hay River bridge, 2 Sep. 1959, *Hj. Eichler* 16082 (AD, PERTH); 1.3 km along Pool Road from junction with Jones Road, 40 metres to N of road, 13 Feb. 1997, *P. Ellery & C. Godden* W 45.3 (PERTH); Rudyard, Wilsons Inlet, E of Denmark, 13 Jan. 1953, *R. Erickson s.n.* (PERTH); Near Boggy Lake, 6 m [*c.* 9.6 km] SW of Walpole, 2 Dec. 1956, *J.W. Green* 936 (PERTH); Coalmine Beach, Walpole-Nornalup National Park, 12 Aug. 1981, *W. Greuter s.n.* (NSW); Valley of the Giants Road, *c.* 14.5 km E of Walpole, 25 Oct. 1997, *B.J. Lepschi & B.A. Fuhrer* BJL 3666 (MEL, PERTH); 2.4 km W of Angrove Road / Centre Road intersection, 20 metres S of Centre Road, 13 Feb. 1997, *C. McChesney & C. Day* W 36.2 (PERTH); River flow meter area, 2 km NE of Break Rd junction on Denmark River, *c.* 15 km NW of Denmark, 1 Feb. 1980, *J.M. Powell* 1422 (MEL, NSW, PERTH); Mt Manypeaks, E ridge



Western Australian Herbarium
PERTH 03012530

WESTERN AUSTRALIAN HERBARIUM
PERTH, W.A.

EX NATIONAL HERBARIUM OF NEW SOUTH WALES
ROYAL BOTANIC GARDENS, SYDNEY

Monotoca tamarascina F.Muell.

Lat. 35 ° 02 ′S Long. 116 ° 40 ′E

Loc. Mt Hopkins, Walpole-Nornalup National Park, W.A.

Coll. J.M. Powell 1175 Date 15.viii.1979.

Notes Sprawling light green-leaved shrub, 1.5m high. Very fine brown branches. Flowers pale cream-green.
Common in scrub on lower southern slopes.
Photograph. Voucher for chemical analyses.

Dupl. to: PERTH, K, L, CANB,CBG, AD

HOLOTYPE

Herbarium of Northern Territory
Alice Springs

Dielsiodoxa lycopodioides Albr.

D.E. Albrecht 5/8/2010

Figure 2. Holotype of *Dielsiodoxa lycopodioides* Albr. (PERTH 03012530), scale = 2cm.

track and plateau area, 27 Aug. 1986, *J.M. Powell* 2662 (HO, NSW, PERTH); 4 miles [*c.* 6.4 km] W of Denmark, 17 Sep. 1966, *E.M. Scrymgeour* 1152 (PERTH); Approx. 1 Meile [mile = *c.* 1.6 km] W Denmark, 4 Nov. 1963, *H.U. Stauffer* 5376 *& R.D. Royce* (PERTH); Site 136, 7 km SW of Mount Frankland, 3 Sep. 1997, *D. Trenowden* 057 (PERTH); Deep River bridge between Walpole and Weld River, 13 Sep. 1963, *J.H. Willis s.n.* (MEL, PERTH).

Distribution. Endemic to south-west Western Australia. Collections have been made from three discrete areas centred on Walpole, Denmark and Mt Manypeaks (Figure 1). These places are amongst the wettest in south-west Western Australia.

Habitat. Occurs in a range of habitats including rocky hillsides, sandy, loamy or gravely flat terrain, and somewhat swampy areas. Associated vegetation is equally diverse floristically and structurally, including forest, woodland, shrubland, scrub and heathland. Frequently recorded associated taxa include *Eucalyptus marginata*, *Corymbia calophylla*, and species of *Agonis*, *Taxandria*, *Acacia*, *Allocasuarina* and *Pteridium*.

Phenology and reproductive biology. Flowering specimens have been collected between March and November. Keighery (1996: 352), based on observations made by J.S. Pate at Denmark, states that *Dielsiodoxa lycopodioides* [as *Monotoca tamariscina*] is pollinated by mosquitoes and tipulid flies.

Conservation status. A reasonable number of good sized populations are known and a conservation nomination is presently considered unjustified. However, the species has been noted [as *Monotoca tamariscina*] as susceptible to *Phytophthora cinnamomi* (Lyons 2008), and it is conceivable that populations could decline in the future. It occurs within Walpole-Nornalup National Park.

Etymology. The epithet indicates a superficial resemblance to some members of the family Lycopodiaceae.

Affinities. *Dielsiodoxa lycopodioides* as here defined was included under *Monotoca tamariscina* by Blackall and Grieve (1981). *Dielsiodoxa lycopodioides* is similar to *D. tamariscina* but differs in having glabrous corollas, minutely pustulate ovaries and smaller fruits. Although herbarium data indicates that *Dielsiodoxa lycopodioides* plants are variable in height, they are probably generally taller than *D. tamariscina*. A distinctive feature of *Dielsiodoxa lycopodioides* plants are their very fine branchlets.

Notes. Two specimens from the Stirling Ranges are tentatively placed here although they are not mapped in Figure 1. The material is poor and it has not been possible to confidently determine whether they are aberrant *Dielsiodoxa lycopodioides* or an undescribed taxon. These specimens—Stirling Ranges, 13 Nov. 1944, *R.J. Moir s.n.* (PERTH 03012484) and Bluff Knoll, Stirling Ranges, 12 Nov. 1961, *A.S.George 3127* (PERTH 02570408)—appear to be similar to *D. lycopodioides* but have a very short corolla tube and distinctly elongated papillae on the distal half of the ovary. Further fertile specimens including flowers and fruits are required to resolve the status of this material.

4. **Dielsiodoxa propullulans** Albr., *sp. nov.*

D. leucanthae affinis sed axe ramulorum fertilium sub anthesi.plerumque ultra nodis fertililibus supremis extenso et foliis latioribus inflorescentiis subtentis differt.

Typus: SW base of Mt Ragged Western Australia, 24 Nov. 1985, *A.N. Rodd* 5176 (*holo*: PERTH 01178369!; *iso*: NSW!).

Monotoca sp. Mt Ragged (C.A. Gardner 2860), Western Australian Herbarium, in *Florabase* http://florabase.dec.wa.gov.au [accessed November 2010]; D.E.Albrecht, C.T.Owens, C.E.Weiller, & C.J.Quinn, *Austral. Syst. Bot.* 23: 320–332 (2010).

Dielsiodoxa oligarrhenoides auct. non (F.Muell.) Albr.: W.E.Blackall & B.J.Grieve, *How to know W. Austral. Wildfl.* IIIB: 313 (1981).

Illustration. W.E.Blackall & B.J.Grieve, *How to know W. Austral. Wildfl.* IIIB: 313 (1981) as *Monotoca oligarrhenoides*.

Erect multi-stemmed *shrub c.* 0.1–1 m high. *Main stems and branches* grey to grey-brown, with longitudinally cracking persistent bark; *lateral branchlets* moderately coarse, straight rarely curved, grey-brown to brown, with an indumentum of variously orientated overlapping hairs 0.05–0.10 mm long, leaf abscission scars 0.4–0.7 mm wide. *Leaves* erect, helical, densely imbricate with *c.* 30–50 leaves per cm, typically many persisting in dried specimens, readily abscising when touched, broadly ovate, depressed ovate or rarely broadly rhombic-elliptic, 1.3–3.0 mm long, 1.3–2.5 mm wide, (current seasons leaves with l:w ratio of 0.7–1.6:1), moderately thin-textured, concave adaxially in proximal half and more or less plane above, saddle-shaped in longitudinal section, not keeled abaxially, adaxial and abaxial surfaces glabrous, concolorous, 7–13 veins weakly visible at least on the abaxial surface; margins with an extremely narrow hyaline fringe, minutely ciliolate-serrulate, sometimes with longer hairs to 0.1mm long on lower margins; apex acute although sometimes appearing obtuse due to the hidden tip that is at right angles to the axis of the leaf, abruptly incurved, mucronulate or rarely lacking a mucro. *Inflorescences* 1–4(–6)-flowered, borne on branchlets in a comparatively long fertile section, the axis of fertile branchlets usually continuing growth beyond the uppermost fertile nodes at anthesis, new growth sometimes also shooting from within fertile section of branchlet; *spike axis* 0.7–2.0 mm long including peduncle 0.3–1.0 mm long; *bracts* ovate to rhomboid-ovate, often boat-shaped, 0.2–0.5 mm long, sterile proximal bracts absent or 1 or 2(–4) present; *bracteoles* broadly ovate to broadly rhomboid-ovate, 0.3–0.4 mm long, 0.2–0.4 mm wide. *Sepals* ovate to ovate-elliptic, 0.6–0.9 mm long, 0.4–0.5 mm wide, apex obtuse or subacute. *Corolla* 5-lobed, mostly described as white or cream in vivo at anthesis but label data also includes greenish-white or yellowish-green, presenting as brown post-anthesis in dried material, 1.4–2.0 mm long, glabrous; *tube* 0.5–0.8 mm long, mostly hyaline (most pronounced when fruiting); *lobes* 0.7–1.2 mm long, 0.4–0.6 mm wide, acute to subacute. *Anthers* 0.15–0.30 mm long; free part of filaments 0.3–0.6 mm long. *Nectary scales* narrowly lanceolate-deltoid to linear, 0.3–0.5 mm long, 0.05–0.15 mm wide, acute to obtuse. *Ovary* somewhat reddish (in rehydrated material), ovoid, ellipsoid or obovoid, 0.8–1.2 mm long, 0.5–0.7 mm wide, textured by slightly raised elongated surface cells, 2(3)-locular, style 0.1–0.2 mm long. *Fruit* dry and brownish-black in dried material, ovoid to broadly ellipsoid-globose, broadly ellipsoid to circular in cross-section, 1.1–1.4 mm long, 0.8–1.1 mm wide, almost smooth to textured by slightly raised elongated surface cells. (Figure 3)

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 6 Jan. 1979, *B. Barnsley* 289 (CANB, NSW); 16 Apr. 1995, *S. Barrett* 357 (PERTH); 10 Apr. 1974, *M.I.H. Brooker* B4512 (PERTH); 1 Jul. 1976, *D.J. McGillivray* 3620 & *A.S. George* (NSW, PERTH); 21 Sep. 2002, *P.M. Olde* 02/232 & *N. Marriott* (NSW); 30 Jul. 1986, *J.M. Powell* 2231 (NSW, PERTH); 30 Jul. 1986, *J.M. Powell* 2231A (NSW, PERTH); 24 Nov. 1985, *J.M. Powell* 3469 (NSW); 5 Dec. 1971, *R.D. Royce* 10112 (PERTH); 18 May 1967, *P.G. Wilson* 5850 (PERTH); 1 Nov. 1968, *J.W. Wrigley s.n.* (CANB, NSW).

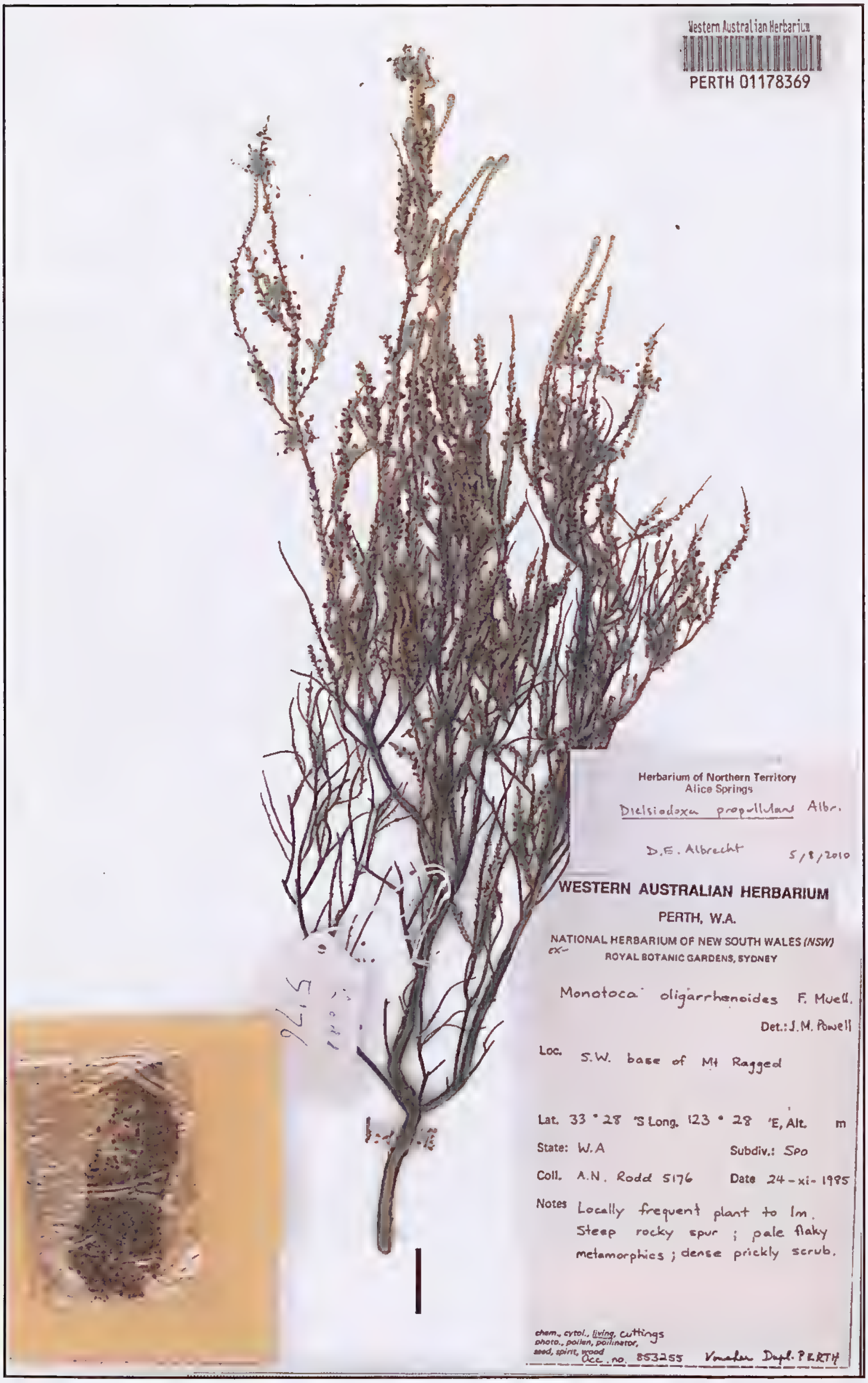

Western Australian Herbarium
PERTH 01178369
5176
Herbarium of Northern Territory
Alice Springs
Dielsiodoxa propullulans Albr.
D.E. Albrecht 5/8/2010
WESTERN AUSTRALIAN HERBARIUM
PERTH, W.A.
NATIONAL HERBARIUM OF NEW SOUTH WALES (NSW)
ex-
ROYAL BOTANIC GARDENS, SYDNEY
Monotoca oligarrhenoides F. Muell.
Det.: J.M. Powell
Loc. S.W. base of Mt Ragged
Lat. 33 ° 28 'S Long. 123 ° 28 'E, Alt. m
State: W.A
Subdiv.: Spo
Coll. A.N. Rodd 5176
Date 24-xi-1985
Notes Locally frequent plant to 1m. Steep rocky spur ; pale flaky metamorphics ; dense prickly scrub.
chem., cytol., living, cuttings
photo., pollen, pollinator,
seed, spirit, wood
Acc. no. 853255
Voucher Dupl. PERTH

Figure 3. Holotype of *Dielsiodoxa propullulans* Albr. (PERTH 01178369), scale = 2cm.

Distribution. Endemic to the Mt Ragged massif and The Diamonds Hill in south west Western Australia (Figure 1). All known populations occur within Cape Arid National Park.

Habitat. Occurs in heathland, low scrub or heathy mallee on rocky or gravely hills. Recorded as occurring on quartzite, granite and gneiss geologies, with sandy to loamy soils. Associated taxa include *Eucalyptus doratoxylon*, *E. tetraptera*, *Taxandria linearifolia*, *Banksia prolata* subsp. *archeos* and *Gastrolobium pycnostachyum*.

Phenology. Flowering specimens have been collected between March and August, and between October and January, but it probably flowers throughout the year if conditions are suitable.

Conservation status. Recently listed as Priority Two under DEC Conservation Codes for Western Australian Flora. Although currently locally common, the highly restricted distribution of this species may jeopardize its chances of survival if subjected to a significant threatening process, such as *Phytophthora cinnamomi*.

Etymology. The epithet derives from the Latin *propullulans* (shooting forth), and refers to the way in which the axis of fertile branchlets usually extends beyond the uppermost fertile nodes at anthesis.

Affinities. *Dielsiodoxa propullulans* is most similar to *D. leucantha*, the two differing in regard to the character of the leaves subtending the inflorescences and in the way new growth is initiated on fertile branchlets. *D. propullulans* has inflorescence-subtending leaves which are broadly ovate to depressed ovate, 1.5–2.2 mm wide and with an apex at right angles to the axis of leaf. In *D. leucantha* by contrast these leaves are broadly rhombic-elliptic to broadly rhombic-ovate, 0.6–1.5 mm wide and usually with the apex at an angle of 45 degrees or less relative to the leaf axis. And whereas *D. propullulans* usually has strong new growth continuing beyond the upper fertile nodes, in *D. leucantha* new growth issues from below the fertile section of the branchlet. The two species are allopatric with *D. propullulans* occurring more than 300 kilometres to the east of the easternmost known population of *D. leucantha*.

Notes. The name *Monotoca oligarrhenoides* was misapplied by Blackall and Grieve (1981) to specimens here treated as *Dielsiodoxa propullulans*.

5. Dielsiodoxa leucantha (E.Pritz.) Albr., *Austral. Syst. Bot.* 23: 330 (2010). *Monotoca leucantha* E.Pritz. in Diels & E.Pritz., *Bot. Jahrb. Syst.* 35: 480, fig. 53 (1904). *Type citation*: 'in distr. Avon septentrionali pr. Moore River in lapidosis montium "Babilon Hills" flor. m.', August [1901], *L. Diels* 4028 (*holo*: B, *n.v.*, presumably destroyed in WWII). *Neotype*: Babilion Hills, Mogumber, Western Australia, 25 September 1934, *C.A. Gardner s.n.* (*neotype*, here designated: PERTH 01244922!; *isoneotypes*: CANB!, K!, MEL!, NSW!).

Erect densely branched *shrub* 0.2–1.3 m high. *Main stems and branches* grey to grey-brown, with longitudinally cracking persistent bark; *lateral branchlets* moderately fine, straight to curved, grey-brown to brown, with an indumentum of variously orientated overlapping hairs 0.05–0.10 mm long, leaf abscission scars (0.3–)0.4–0.7 mm wide. *Leaves* erect, helical, densely imbricate with *c.* 24–50 leaves per cm, typically many persisting in dried specimens, readily abscising when touched, broadly rhombic-elliptic to broadly rhombic-ovate, 1.3–3.0 mm long, 0.9–1.7 mm wide, (current seasons leaves with l:w ratio of 1–2.1:1), moderately thin-textured, concave adaxially in proximal half and more or less plane above, saddle-shaped in longitudinal section, not keeled abaxially, adaxial and abaxial surfaces glabrous, concolorous, 7–11 veins usually weakly visible at least on the abaxial surface; margins usually with an extremely narrow hyaline fringe, minutely ciliolate-serrulate, sometimes with longer hairs to 0.1mm long on lower margins; apex acute to acuminate, almost straight to incurved, with the tip very occasionally at right angles to the axis of the leaf, lacking a mucro or mucronulate. *Inflorescences* 1–5-flowered, borne on branchlets in a distal fertile section, the axis of fertile branchlets not continuing growth beyond the uppermost fertile nodes at anthesis, or producing very short abortive growth, new growth more often shooting from below fertile section of branchlet; *spike axis* 0.7–2.5 mm long including peduncle 0.3–1.0 mm long; *bracts* ovate to rhomboid-ovate, often boat-shaped, 0.1–1.0 mm long, sterile proximal bracts typically 2, rarely only 1 or 3–5 present; *bracteoles* ovate to depressed ovate, 0.3–0.8 mm long, 0.3–0.6 mm wide, acute to obtuse. *Sepals* ovate-elliptic, ovate, broadly ovate to almost orbicular, 0.5–1.1 mm long, 0.30–0.65 mm wide, acute to obtuse. *Corolla* 5-lobed, white to cream in vivo at anthesis (rarely recorded as pale yellow), presenting as brown post-anthesis in dried material, 1.5–2.1 mm long, glabrous; *tube* 0.5–1.0 mm long, mostly hyaline (most pronounced when fruiting); *lobes* 0.9–1.3 mm long, 0.5–0.8 mm wide, acute to subacute. *Anthers* 0.15–0.40 mm long; free part of filaments 0.3–0.8 mm long. *Nectary scales* narrowly elliptic, lanceolate, oblong, oblanceolate or obovate, 0.25–0.70 mm long, 0.10–0.25 mm wide, acute to obtuse, sometimes bilobed. *Ovary* somewhat reddish (in rehydrated material), ovoid to ellipsoid, 0.8–1.2 mm long, 0.5–0.7 mm wide, textured by slightly raised elongated surface cells, 2-locular, style 0.1–0.2 mm long, stigma cleft 0.02–0.18 mm deep. *Fruit* dry and brownish-black in dried material, ovoid to broadly ellipsoid, circular in cross-section, 1.0–1.4 mm long, 0.6–1.0 mm wide, almost smooth to textured by slightly raised elongated surface cells.

Typification. Specimens of Ericaceae subf. Styphelioideae were apparently among those that were completely destroyed by the bombing raids of Berlin during the Second World War (Botanical Museum Berlin-Dahlem 1999). According to Stafleu and Cowan (1976), Diels' Australian specimens are also housed at BM, CANB and MEL. An attempt to relocate type material at these institutions has proven unfruitful. Although the protologue includes an excellent illustration we have opted to designate a specimen as the neotype rather than rely solely on the illustration. The neotype is from the same small range of hills as the holotype and conforms well with the protologue.

Affinities. In general appearance *Dielsiodoxa leucantha* resembles *D. oligarrhenoides* but is readily distinguished by the strictly helical, rather than mostly decussate, leaf arrangement. It shares a number of features with *Dielsiodoxa propullulans*, differing in the shape, width and apex of leaves subtending the inflorescence and the way new growth is initiated on fertile branchlets. These differences are presented in detail under *D. propullulans*.

Two geographically separated subspecies are recognised.

Dielsiodoxa leucantha (E.Pritz.)Albr. subsp. **leucantha**

Illustrations. Diels & E.Pritz, *Bot. Jahrb. Syst.* 35: 480–481 (1904) as *Monotoca leucantha*; W.E.Blackall & B.J.Grieve, *How to know W. Austral. Wildfl.* IIIB: 313 (1981) as *Monotoca leucantha.*

Bracteoles usually acute or subacute, rarely obtuse, ovate to broadly ovate (usually longer than wide) 0.4–0.7 (–0.8) mm long. *Sepals* usually acute or subacute, occasionally obtuse 0.7–1.1 mm long. *Corolla tube* (0.65–)0.75–1.0 mm long. *Nectary scales* variously shaped from oblong, lanceolate, oblanceolate to narrowly elliptic, (0.3–)0.45–0.70 mm long. *Stigma cleft* 0.05–0.18 mm deep.

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 16 Sep. 1992, *B. & B. Backhouse* BM168 (PERTH); 29 Apr. 1994, *R.M. Buehrig* 94.04.29 (10) (PERTH); 9 Sep. 1996, *A.M. Coates, R. Cugley, E. Bishop & J. Stewart* 4418 (CANB, PERTH); 12 Oct. 2003, *D.M. Crayn* 723 (K, NSW, NYBG, PERTH, WFU); 14 Nov. 1990, *E.A. Griffin* 6150 (PERTH); 3 Sep. 1970, *K.R. Newbey* 3351 (PERTH).

Distribution. Endemic to south-west Western Australia. This taxon has an unusual and rather anomalous distribution comprising two very disjunct population nodes—a small western one near Mogumber (south of Moora), and a larger eastern occurrence centred to the east and south-east of Hyden. The eastern node itself has a couple of outlying populations near Bruce Rock and Hatters Hill (Figure 1). This subspecies has the most northerly and inland distribution of any member of the genus.

Habitat. Populations occur in open woodland, heathland or open shrub mallee and are usually associated with breakaways, often with white soils and quartz and/or lateritic gravel.

Phenology. Flowering specimens have been collected between July and October.

Conservation status. Dielsiodoxa leucantha is currently listed as Priority Three under DEC Conservation Codes for Western Australian Flora (Smith 2010), under the name *Monotoca leucantha*. Although there is no obvious justification for maintaining either subspecies on the Priority List, the situation in relation to the typical subspecies is complicated by the fact that, as circumscribed here, the latter comprises two forms which are widely separated geographically. The western or type form, is currently known from just two populations, only one of which is protected in the Conservation Estate. The only significant difference between it and the eastern form appears to be that it has narrower corolla lobes and there is also a tendency to larger leaves. The authors felt that, in the absence of other data, this morphological basis was inadequate for the recognition of another taxon. However, although apparently slight, the corolla difference is consistent. In these circumstances, because of the conservation implications, it would be desirable to utilize molecular sequence data to investigate relationships between the different forms of this subspecies (and including subsp. *obtusa*), in order to assess whether the classification used here requires modification. Following the precautionary principle, until such time as a study of this kind can be undertaken, this taxon will remain Priority 3.

Dielsiodoxa leucantha (E.Pritz.) Albr. subsp. **obtusa** Hislop & Albr., *subsp. nov.*

D. leucanthae subsp. *leucanthae* affinis sed bracteolis et sepalis obtusis, sepalis, tubo corollae et squamis nectarii brevioribus differt.

Typus: Fitzgerald River National Park, Mount Maxwell, track to lookout, Western Australia, 16 July 2010, *C. Puente-Lelièvre & E.A. Brown* CPL 93 (*holo*: PERTH 08228655!; *iso*: MEL!, NSW!).

Monotoca leucantha subsp. Stirling Range (D.M. Crayn 80); D.E.Albrecht, C.T.Owens, C.E.Weiller, & C.J.Quinn, *Austral. Syst. Bot.* 23: 320–332 (2010).

Bracteoles usually obtuse, rarely subacute, broadly ovate to depressed-ovate (usually shorter than wide), 0.30–0.50 (–0.55) mm long. *Sepals* usually obtuse, occasionally subacute, 0.50–0.75 (–0.85) mm long. *Corolla tube* 0.5–0.8 mm long. *Nectary scales* obovate to oblong-obovate, 0.25–0.40 (–0.55) mm long. *Stigma cleft* 0.02–0.10 mm deep. (Figure 4)

Selected specimens examined. WESTERN AUSTRALIA: Bell Track ca 4.5 km S of northern (internal) fireline, 24 Mar. 2004, *S. Barrett* 1212 (PERTH); Stirling Range National Park, Hosteller Hills, 21 Jun. 2007, *S. Barrett* 1613 (PERTH); 30m along trail to Pillenorup Swamp after entering Stirling Range National Park on Chester Pass Rd from the South, 2 Oct. 1995, *D.M. Crayn* 68 (UNSW); Fitzgerald River National Park, 1–2 km N of Quaalup, 19 Oct. 1991, *W. Greuter* 22985 (PERTH); Ridgeline below Ellen's Peak, SW Stirling Ranges, 11 May 1982, *G.J. Keighery* 4938 (PERTH); Mt Bland, 6 Apr. 1963, *K.R. Newbey* 734 (PERTH); Mt Maxwell, slopes below summit, 17 Nov. 1985, *J.M. Powell* 3336 (NSW, PERTH); West Mt Barren, 18 Nov. 1985, *J.M. Powell* 3363 (NSW, PERTH, HO).

Distribution. Endemic to south-west Western Australia, where it is apparently confined to the Fitzgerald River and Stirling Ranges National Parks (Figure 1). Its distribution lies well to the south of the typical subspecies.

Habitat. Occurs in heathland or mallee heath, usually on hillslopes with stony or rocky sandy (rarely peaty-sand) soils. Recorded once on a flat depression with deep white sand. Occurs in the vicinity of *Dielsiodoxa tamariscina* in the eastern Stirling Ranges.

Phenology. Flowering specimens have been collected between March and September.

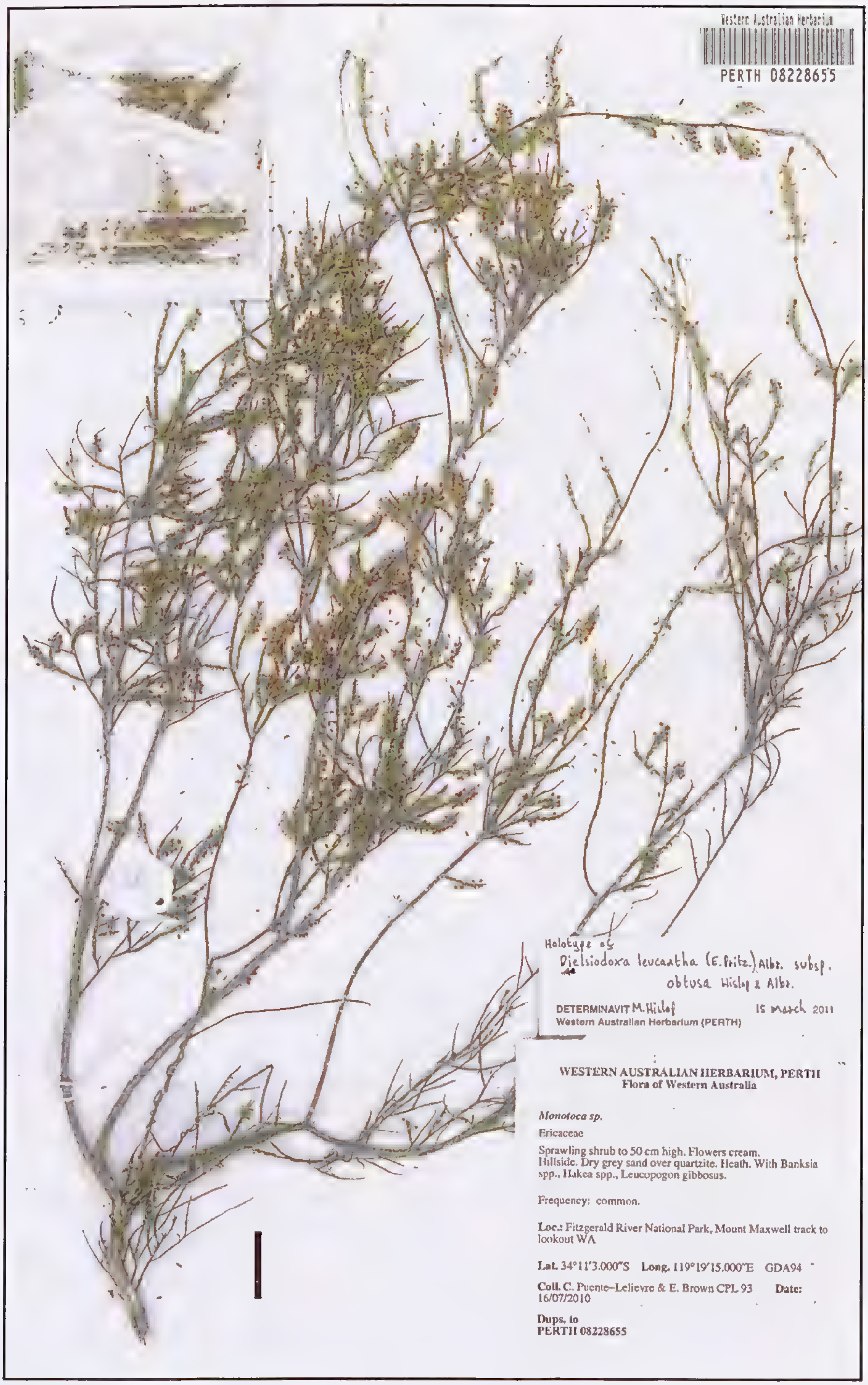
Conservation status. This taxon is locally common in the Fitzgerald River National Park and no conservation code is recommended here. However, because it is very likely to be susceptible to *Phytophthora cinnamomi* its status may need to be reviewed as that pathogen inevitably spreads within the park.

Etymology. The epithet refers to the obtuse bracteoles and sepals.

Notes. Because of limited overlap in most of the characters used to separate this taxon from typical *D. leucantha*, the rank of subspecies was considered the most appropriate to apply. However the two taxa are generally easily distinguished from each other, subsp. *obtusa* differing in its shorter usually obtuse bracteoles and sepals, shorter corolla tube, shorter and broader nectary scales, and less deeply cleft stigma. In addition there are potential differences in habit and phenology that need further investigation. As suggested above a molecular study of infraspecific relationships within *D. leucantha* would be particularly valuable and may indicate that subsp. *obtusa* is better treated as a separate species.

Acknowledgements

We thank the directors of CANB, MEL, NSW, PERTH and UNSW for loan of specimens and access to their collections. John Hunnex (BM) and Clare Drinkell (K) kindly checked collections at their herbaria and sent digital images of potential types. Neville Walsh, Graham Bell and Brendan Lepschi checked for types at MEL, AD and CANB respectively. Paul Wilson provided nomenclatural advice and prepared the Latin diagnoses, and Juliet Wege prepared the distribution map. Rob Davis, Sarah Barrett and Mavis Sowry kindly went out of their way to collect DNA samples of *Dielsiodoxa*. We also acknowledge Chris Quinn's invaluable support and Kevin Thiele's assistance in facilitating the completion of this work.



Holotype of
Dielsiodoxa leucantha (E.Pritz.) Albr. subsp.
obtusa Hislop & Albr.

DETERMINAVIT M.Hislop 15 march 2011
Western Australian Herbarium (PERTH)

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Monotoca sp.

Ericaceae

Sprawling shrub to 50 cm high. Flowers cream.
Hillside. Dry grey sand over quartzite. Heath. With Banksia spp., Hakea spp., Leucopogon gibbosus.

Frequency: common.

Loc.: Fitzgerald River National Park, Mount Maxwell track to lookout WA

Lat. 34°11'3.000"S Long. 119°19'15.000"E GDA94

Coll. C. Puente-Lelievre & E. Brown CPL 93 Date: 16/07/2010

Dups. to
PERTH 08228655

Figure 4. Holotype of *Dielsiodoxa leucantha* subsp. *obtusa* Hislop & Albr. (PERTH 08228655), scale = 2 cm.

References

Albrecht, D.E., Owens, C.T., Weiller, C.E. & Quinn, C.J. (2010). Generic concepts in Styphelieae: the *Monotoca* group. *Australian Systematic Botany* 23: 320–332.

Bell, T.L. (1995). *Biology of Australian Epacridaceae: with special reference to growth, fire response and mycorrhizal nutrition.* PhD thesis, Department of Botany, University of Western Australia, p 251.

Bell, T.L., Pate, J.S. & Dixon, K.W. (1996). Relationships between fire response, morphology, root anatomy and starch distribution in south-west Australian Epacridaceae. *Annals of Botany* 77: 357–364.

Blackall, W.E. & Grieve, B.J. (1981). *How to know Western Australian wildflowers*. Part IIIB, 2nd edn. (University of Western Australia Press: Nedlands, WA.)

Botanical Museum Berlin-Dahlem (1999). *List of families including extant collections of the Botanical Museum Berlin-Dahlem (B) from the time before 1943*. http://www.bgbm.fu-berlin.de/BGBM/research/colls/herb/phanerog.htm [accessed January 2011]

Diels, L. & Pritzel, E (1904). Fragmenta phytographiae Australiae Occidentalis. *Botanische Jahrbucher* 35: 480–481.

Keighery, G.J. (1996). Phytogeography, biology and conservation of Western Australian Epacridaceae. *Annals of Botany* 77: 347–355.

Lyons, M. (2008). *A study into the risk of Phytophthora dieback in Ten Peri-urban Reserves within the Shire of Denmark.* (Project Dieback: Perth.)

Smith, M.G. (2010). *Declared Rare and Priority Flora List for Western Australia.* (Dept of Environment and Conservation: Kensington, WA.)

Stafleu, F.A. & Cowan, R.S. (1976). *Taxonomic literature.* Vol. 1. 2nd ed. (Bohn, Scheltema & Holkema: Utrecht.)

Stuppy, W. (2004). *Glossary of seed and fruit morphological terms*. (Seed Conservation Department, Royal Botanic Gardens: Kew, England.)

Wheeler, J., Marchant, N. & Lewington, M. (2002). *Flora of the south west: Bunbury-Augusta-Denmark.* Vol 2, Dicotyledons. (Australian Biological Resources Study: Canberra.)

Sida picklesiana (Malvaceae), a new species from the Murchison-Gascoyne region of Western Australia

Adrienne S. Markey[1], Steven J. Dillon[2], Geoff T.B. Cockerton[3] and Robyn M. Barker[4]

[1]Science Division, Department of Environment and Conservation, Locked Bag 104,
Bentley Delivery Centre, Western Australia 6983
[2]Western Australian Herbarium, Department of Environment and Conservation, Locked Bag 104,
Bentley Delivery Centre, Western Australia 6983
[3]Western Botanical, Landcare Holdings Pty Ltd, Environmental Consultants,
19 McDonald Crescent, Bassendean, Western Australia 6054
[4]State Herbarium of South Australia, Department of Environment and Natural Resources,
P.O. Box 2732, Kent Town, South Australia 5071

Abstract

Markey, A.S., Dillon, S.J., Cockerton, G.T.B. & Barker, R.M. *Sida picklesiana* (Malvaceae), a new species from the Murchison-Gascoyne region of Western Australia. *Nuytsia* 21(3): 127–137 (2011). This article provides a description of the recently discovered species *Sida picklesiana* A.S.Markey, S.J.Dillon & R.M.Barker. This species is known from an area near Wiluna in Western Australia's Murchison-Gascoyne region, where it occurs in a variety of habitats. *Sida picklesiana* has conservation priority status as it has a relatively limited distribution. Major differences between *S. picklesiana* and the species with which it is most likely to be confused are discussed, and the most recently published draft key to *Sida* is amended to include this new species.

Introduction

The genus *Sida* L. (Malvaceae) is a common and diverse component of the flora of central Australia. It is also a taxonomically problematic group, and nearly half of the 62 taxa recognized in Western Australia are currently undescribed (Western Australian Herbarium 1998–). Barker (2007) produced a draft key to Western Australian species of *Sida s. lat.* as part of an ongoing revision of the genus. *Sida picklesiana* was unknown at that time, and is described here as a new species from the Murchison and Gascoyne regions of Western Australia.

Recent vegetation surveys of Banded Iron Formation (BIF) ranges in the Midwest region of Western Australia by the Department of Environment and Conservation (DEC) have found a number of previously unknown species (Gibson *et al.* 2007, Wege *et al.* 2007). One such survey near the township of Wiluna located a population of an unusual *Sida,* and specimens were found to have a combination of characters that did not match any taxon represented in the collections of the Western Australian Herbarium (Markey & Dillon 2009). The floral and vegetative characters were distinctive enough to immediately recognise this as a new entity, and later to assign it the interim phrase name of *Sida* sp. Wiluna (A. Markey & S. Dillon 4126). Unknown to these authors at that time, several populations of a distinctive *Sida* had also been located by G. Cockerton near Mt Keith (*c.* 40 to 65 km south of the Wiluna populations). Examination of fertile material determined that these populations were southern variants of *Sida* sp. Wiluna (A. Markey & S. Dillon 4126).

Formal recognition of *Sida picklesiana* A.S.Markey, S.J.Dillon & R.M.Barker was delayed by a lack of fruiting collections in these initial surveys, as both the schizocarp and fruiting calyx provide diagnostic features in *Sida* (Barker 2007). Recent surveys located both mature fruits and several new populations, allowing for both this entity to be formally described and an amendment to the key for Western Australian *Sida s. lat.* (Barker 2007) to be given in this paper.

Methods

This study was based on an examination of specimens of *Sida* species lodged at the Western Australian Herbarium (PERTH) and the State Herbarium of South Australia (AD). Close comparisons were made of material from species that were similar in appearance, notably from *Sida* sp. dark green fruits (S. van Leeuwen 2260), *S. ectogama* W.R.Barker & R.M.Barker, *S. petrophila* F.Muell., *S. calyxhymenia* DC. and *S.* sp. Petermann Ranges (B.G. Thomson 2340). Informal phrase names cited in this paper are listed on the census of Western Australian plants database of the Western Australian Herbarium (1998–).

Observations and measurements of fruit and vegetative characters were made from dried and wet (70% ethanol) herbarium specimens. Dried flowers were rehydrated for observations, measurements and sectioning. Descriptive terminology follows Barker (2007). Herbarium notes on habit and habitat were supplemented by field observations. A distribution map was generated from herbarium records (PERTH) using DIVA–GIS freeware version 5.0 (http:/www.diva_gis.org/).

Taxonomy

Sida picklesiana A.S.Markey, S.J.Dillon & R.M.Barker, *sp. nov.*

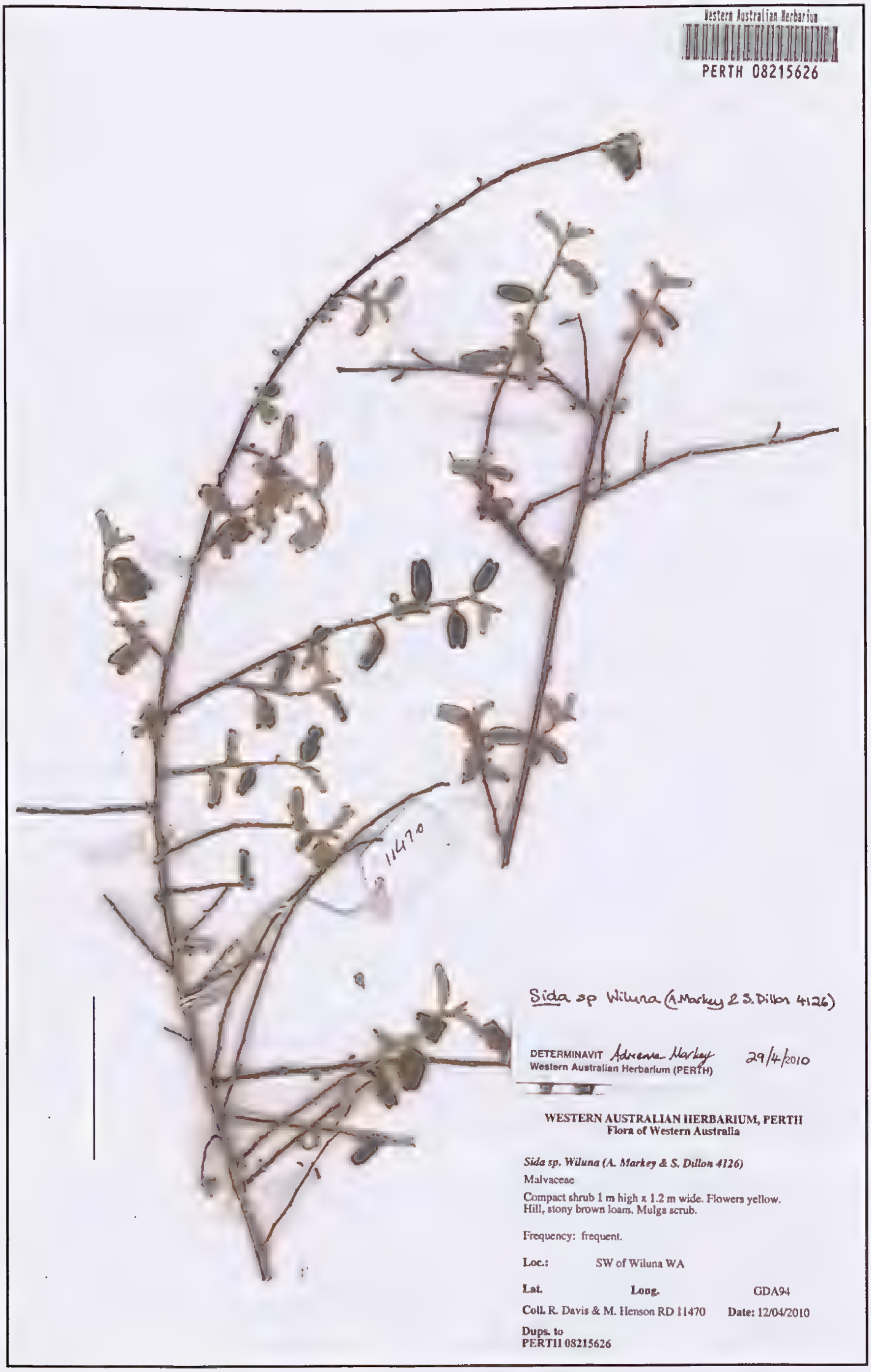
Foliis discoloris et plantis dioeciis S. ectogamae W.R.Barker & R.M.Barker similis, praecipue differt floribus parvioribus subsessilibus, calycis lobis non-accrescentibus, marginibus foliorum integris (non-crenulatis), et columna stamineali glabra.

Typus: south-west of Wiluna, Western Australia [precise locality withheld for conservation reasons], 12 April 2010, R. Davis & M. Henson RD 11470, with female flowers and fruit (*holo*: PERTH 08215626; *iso*: AD); 12 April 2010, R. Davis & M. Henson RD 11471b, with male flowers and fruit (*topo*: AD, PERTH 07984022).

Sida sp. Wiluna (A. Markey & S. Dillon 4126), Western Australian Herbarium, in *FloraBase*, http://florabase.dec.wa.gov.au/ [accessed January 2011].

Woody perennial shrub, 0.4–1.0(–1.5) m high and 0.8–1.0(–1.2) m wide, compact, rounded, densely branched, twiggy; root morphology and regenerative capacity from rootstock unknown. *Branches* divaricate, more densely so when browsed, densely pubescent when young, glabrescent and becoming weathered, scurfy and grey with age; branchlets sometimes clustered in dense fascicles, rounded; leaf abscission scars present; bark smooth, minutely fissured with age. *Indumentum* in all parts of sessile to shortly stipitate, eglandular, stellate, colourless or white to golden-yellow hairs. *Leaves* alternate, distinctly discolorous, petiolate; petiole 1–3(–4) mm; lamina ovate or oblong to narrowly ovate-oblong or depressed obovate, (5–)10–20(–40) × (3–)4–8(–11) mm, usually 4–9 times petiole length, sometimes folded such that upper two halves of the blade are appressed to each other; base rounded; margin entire or occasionally with 1–2 pairs of serrations; apex truncate or emarginate, often with midrib extended by *c.* 0.5 mm; adaxial surface dark olive green, often aging to brown-red, with dense indumentum of colourless, sessile stellate hairs 0.1–0.2(–0.3) mm in diameter, the rays appressed to slightly ascending; abaxial surface and leaf margins pale golden-yellow or pale green with indumentum of very dense, white to golden-yellow, sessile to shortly stipitate stellate hairs 0.3–0.5(–0.6) mm in diameter, the rays ascending to erect; venation reticulate, obscured above, raised below. *Stipules* in pairs at petiole base, usually only present on younger growth but scars visible on older growth, linear to subulate-linear, 0.5–3.6(–4.0) mm long, the indumentum as on petiole and lamina but apex glabrescent. *Flowers* subsessile, axillary, solitary or paired in leaf axils of newer growth, unisexual on generally dioecious plants (occasional fruits from female flowers observed on male plants). *Buds* ellipsoid to subglobose, faintly 5 grooved at apex, erect. *Pedicels* 0.4–3.0(–3.6) mm long in flower, 0.8–3.0 mm long in fruit, with dense, sessile, white to golden stellate hairs, basally articulate. *Calyx* (3–)4–5 mm long, synsepalous with five lobes, lobed to middle third, broadly cupular in open flower, persistent in fruit, non-accrescent, without longitudinal striations, abaxial surface stellate-hairy, adaxial surface of tube glabrous, of lobes with puberulous hairs, loosely enclosing base of schizocarp; lobes broadly triangular with acute to acuminate apex, 1.3–2.7 mm long, 1.2–2.3 mm wide at base. *Corolla* yellow, glabrous, just exceeding calyx; (4.0–)5.0–8.0 mm in diameter; claw 0.2–0.5 mm long, ciliate; lobes spathulate, obtuse–emarginate apically, 1.8–3.5(–4.5) mm long, 1.7–3.0 mm wide at widest part, non-ciliate. *Stamens* 20(–23) per flower; filaments connate into a tube around the styles for much of their length; free parts arranged regularly at apex, all equal, 0.8–1.1 mm long in male flowers, 0.1–0.2 mm long in female flowers; staminal column 1.5–2.3 mm long in male flowers, 1.1–1.2 mm long in female flowers, glabrous; anthers in male flowers all fertile, scarcely exserted from the corolla, 0.5–0.8 mm long, reniform, versatile, longitudinally dehiscent by single top suture; pollen yellow; sterile anthers in female flowers much smaller, 0.3–0.4 mm long. *Styles* 5(6), in female flowers 2.2–2.8 mm long, exserted 1.0–1.5 mm beyond staminal column and stamens and just exserted from flower; stigma discoid; styles in male flowers rudimentary and remaining enclosed within the base of the staminal column, 0.4–0.9 mm long and 1/3–1/2 length of staminal column. *Ovary* 0.5–1.0 mm high, 1.0–1.2 mm wide, ovules 5(6), appearing fully developed in male flowers. *Schizocarp* 3.2–4.7 mm diameter, 3.0–4.0 mm high, regular or rarely irregular due to unequal development of mericarps, depressed-ovoid–transversely ellipsoid, raised at centre, green when immature, light brown at maturity, shallowly grooved between mericarps; *mericarps* 5(6), 3.0–3.6 mm high, 1.5–2.2 mm wide, all regular, trigonous, indehiscent, grooved at apex, separating at maturity from each other and columella; dorsal (exposed) surface unornamented, smooth or slightly rugose, with a dense indumentum of minute, short, sessile, stellate hairs; lateral walls (internal faces) prominently reticulate; columella, pedicel and calyx persistent on plant after shedding of mericarps, eventually separating from the branch with age. *Seed* one per mericarp, 2.2 mm long, 1.5 × 1.5 mm wide, trigonous with obtuse outer surface, light brown; surface smooth, villous, with an indumentum of simple, eglandular hairs. (Figures 1–3)

Selected specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 14 Oct. 2010, *G. Cockerton & C. Jowett s.n.* (PERTH); 4 Nov. 2010, *G. Cockerton, D. Brassington & S. Colwill* LCH 29854 (PERTH); 12 Apr. 2010, *R. Davis & M. Henson* RD 11465 (PERTH); 12 Apr. 2010, *R. Davis & M. Henson* RD 11467 (PERTH); 12 Apr. 2010, *R. Davis & M. Henson* RD 11470 (PERTH); 13 Apr. 2010, *R. Davis & M. Henson* RD 11469 (PERTH); 14 Apr. 2010, *R. Davis & M. Henson* RD 11471a (PERTH); 14 Apr. 2010, *R. Davis & M. Henson* RD 11471b (PERTH); 4 Aug. 2010, *R. Davis & M. Henson* RD 11480 (PERTH); 4 Aug. 2010, *R. Davis & M. Henson* RD 11476 (PERTH); 27 Aug. 2006, *D.J. Edinger* 5375 (PERTH); 20 Aug. 2006, *A. Markey & S. Dillon* 4126 (AD, PERTH); 20 Aug. 2006, *A. Markey & S. Dillon* 4306 (PERTH); 21 Aug. 2006, *A. Markey & S. Dillon* 4305 (PERTH); 21 Aug. 2006, *A. Markey & S. Dillon* 4127 (AD, PERTH); 8 Dec. 1995, *A.A. Mitchell* 4149 (PERTH).



Sida sp Wiluna (A.Markey & S.Dillon 4126)

DETERMINAVIT Adrienne Markey 29/4/2010
Western Australian Herbarium (PERTH)

WESTERN AUSTRALIAN HERBARIUM, PERTH
Flora of Western Australia

Sida sp. Wiluna (A. Markey & S. Dillon 4126)
Malvaceae

Compact shrub 1 m high x 1.2 m wide. Flowers yellow.
Hill, stony brown loam. Mulga scrub.

Frequency: frequent.

Loc.: SW of Wiluna WA

Lat. **Long.** GDA94

Coll. R. Davis & M. Henson RD 11470 **Date:** 12/04/2010

Dups. to
PERTH 08215626

Figure 1. Holotype of *Sida picklesiana* (*R. Davis & M. Hensen* 11470), with precise locality obfuscated. Scale bar = 5 cm.

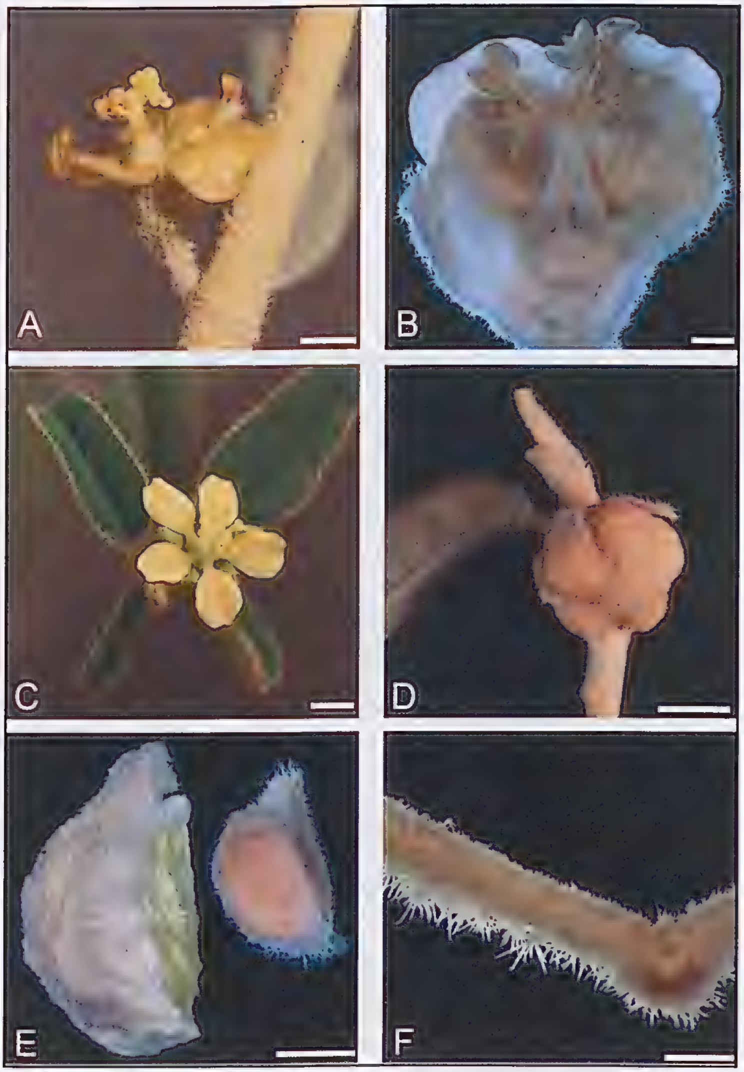


Figure 2. *Sida picklesiana.* A – male flower (scale = 2.0 mm); B – rehydrated male flower sectioned to show the ovary and degenerate style (scale = 0.5 mm) (*R. Davis & M. Henson* RD 11471b); C – female flower (scale = 2.0 mm); D – fruit preserved in ethanol (scale = 2.4 mm) (*R. Davis & M. Henson* RD 11469); E – mericarp and seed (scale = 1.0 mm) (*R. Davis & M. Henson* RD 11469); F – transverse section of rehydrated leaf (scale = 1.0 mm) (*R. Davis & M. Henson* RD 11471b). Images: A – S. Dillon at Herbert Lukin Ridge; B, E, F – A. Markey; C – R. Davis at Doolgunna Station; D – K. Thiele.

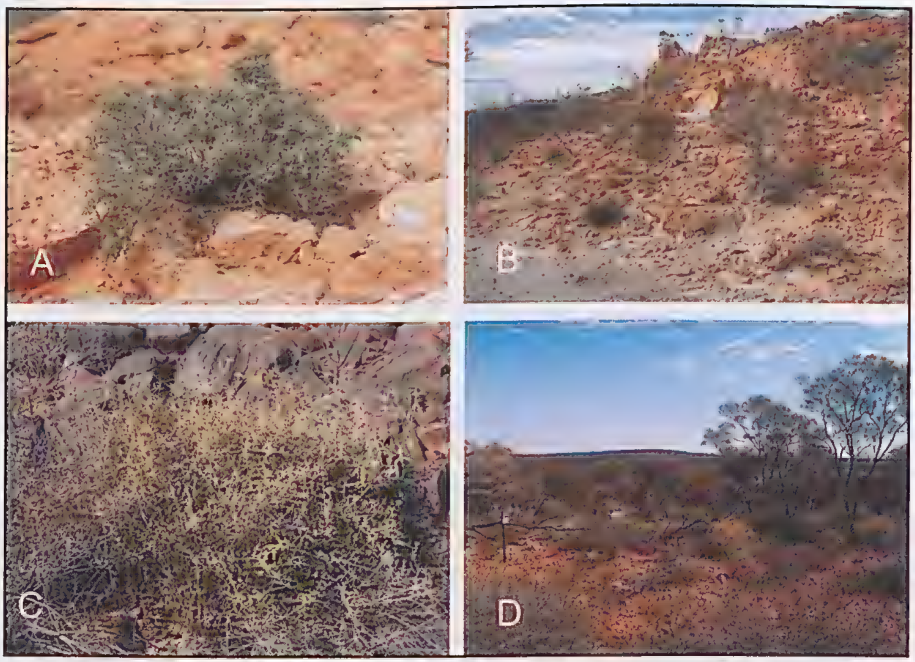


Figure 3. *Sida picklesiana*. A – example of growth habit of plants at a population near Mt Keith; B – typical habitat occupied by populations near Mt Keith; C – typical growth habit of plants at Herbert Lukin Ridge (*A. Markey & S. Dillon* 4126); D – an example of the habitat occupied at Herbert Lukin Ridge. Heavy browsing by macropods at sites near Mt Keith has produced shorter (≤ 0.5 m, densely divaricate shrubs (A, B) relative to unbrowsed shrubs along the Herbert Lukin Ridge (C, D). Photographs by G. Cockerton (A, B) and S. Dillon (C, D).

Distribution. *Sida picklesiana* is found in the Murchison and Gascoyne IBRA regions (Department of the Environment and Water Resources 2008), in an area near the townships of Wiluna, Meekatharra and Leinster (Figure 4). Most records come from locations near Wiluna, Mt Keith and Doolgunna Station. It appears to have a limited distribution, as surveys of BIF ranges in the surrounding Murchison region (Gibson *et al.* 2007; Markey & Dillon 2010; Meissner *et al.* 2009a, 2009b) and nearby calcretes (R. Meissner[1], pers. comm.) have failed to locate it in the wider region.

Ecology. *Sida picklesiana* has been recorded from open *Acacia* (*A. aneura, A. quadrimarginea, A. pruinocarpa, A. balsamea*) woodlands and shrublands on a variety of substrates, often on exposed, rocky habitats on hills of BIF and granite breakways, on footslopes of BIF hills, on stony plains (ironstone and quartz) and near creeklines. Soil types include deeper sandy clays on plains and hardpan and shallow or skeletal sandy clay loams overlying rock. Plants have been observed growing in rock crevices when on outcrops. This species appears to tolerate grazing, although plants become densely divaricate and stunted if this occurs.

Phenology. Fruiting material has been collected in April, flowering material has been collected in April, August and September, and flowering recorded in February (F. Sugg[2], pers. comm.). Flowering and fruiting appears to be rainfall-dependent as surveys during prolonged dry periods have not located reproductive material.

---

[1] Rachel Meissner, Research Scientist, Science Division, Department of Environment and Conservation, Western Australia.

[2] Feigh Sugg, Project Environmental Scientist, Keith Lindbeck and Associates, Bullcreek, Western Australia.

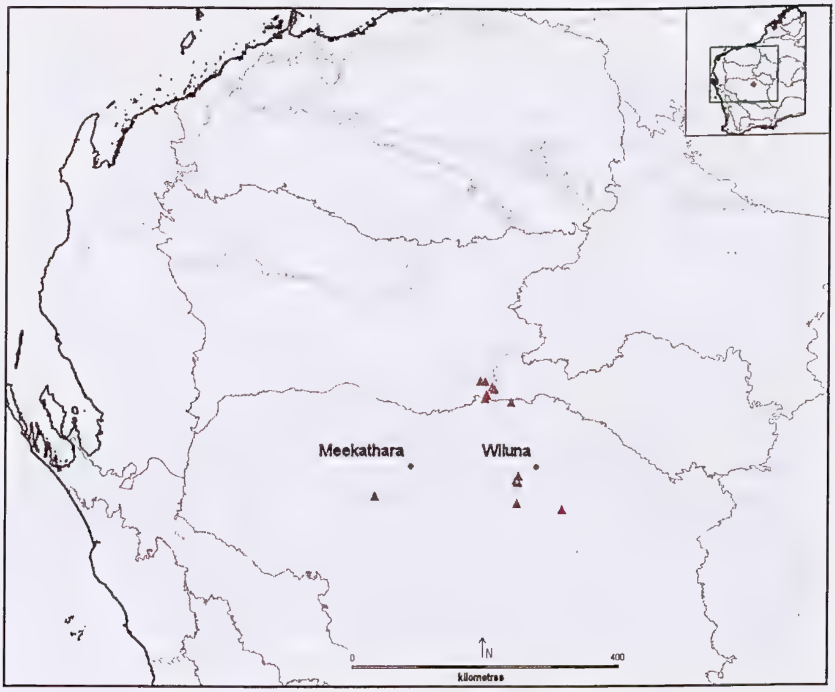


Figure 4: Distribution of *Sida picklesiana* in Western Australia (inset) and relative to nearest major townships, based on specimen data from the Western Australian Herbarium. *Version 6.1 IBRA regions* (Department of the Environment, Water, Heritage and the Arts 2008) indicated in grey.

Gender expression. From both field observations (this study, R. Davis[3], pers. comm.) and an examination of all available herbarium specimens, all have been found to have unisexual flowers and populations have been found to be usually dioecious. On a single collection (*R. Davis & M. Henson* RD 11471b), fruits that had developed from female flowers were found on a plant with male flowers. This suggests that male flowers on this plant may have been preceded by female flowers. Further field investigations are required to document the expression of floral gender in this species and determine how frequently it is monoecious.

Conservation status. Recently listed as Priority Three under the DEC Conservation Codes for Western Australian Flora, under the phrase name *Sida* sp. Wiluna (A. Markey & S. Dillon 4126).

Etymology. Named in honour of David Pickles, a Department of Environment and Conservation Environmental Officer based in Kalgoorlie, who has been an advocate for this species and steadfastly pushed for further inquiry on its distribution, taxonomy and conservation status.

---

[3] Robert Davis, Technical Officer, Western Australian Herbarium, Department of Environment and Conservation, Western Australia

Generic placement

Sida picklesiana belongs within *Sida s. lat.*, along with other Australian species in an unresolved collection of species which lack the characters that define *Sida* section *Sida*, namely the calyx ten-ribbed at the base and a shoulder separating an upper dehiscent and lower indehiscent portion of the fruit (Barker 1998, 2007; Fryxell 1987). The generic limitations of *Sida* and the tribe Malveae are currently under investigation (Fryxell 1985, 1987; Holland & Reynolds 1988; Barker 1998, 2007; Fuertes *et al.* (2003). *Sida sens. lat.* may be split into separate genera in the future as a result of these investigations

Distinguishing features

Sida picklesiana is characterised by the combination of a densely branched, rounded habit with small, subsessile flowers and fruits and distinctly discolorous leaves. Unlike those of most other *Sida* species in the region, the pedicels do not appear to lengthen appreciably in fruit. Relative to the abaxial leaf surface and leaf margins, the adaxial leaf surface is less hairy, with stellate hairs with shorter, appressed rays (Figure 2F). Leaves are truncate or emarginate, ovate or oblong to narrowly ovate–oblong or depressed obovate and entire. Laminas tend to become folded on herbarium specimens, but leaves are held partially or fully open in the field unless plants are drought-stressed.

Most *Sida* species have bisexual flowers, but in a few species these have become functionally unisexual with either the styles or anthers failing to develop fully (Barker 2007). The small flowers of *S. picklesiana* are functionally unisexual, and plants are usually dioecious. Female flowers have fertile styles growing up through and protruding beyond the staminal column while the anthers are much reduced in size, borne on short filaments and do not produce pollen (Figure 2A–C). The calyx does not expand nor become chartaceous during development of the schizocarp (Figure 2D), and the mericarps are small and unornamented. Male flowers have fertile anthers on longer filaments on the apex of the staminal column and no style arms emerging from the top of the staminal column (styles are greatly reduced in size and undeveloped). In one case, fruits have been observed on a plant with otherwise male flowers (*R. Davis & M. Henson* RD 11471b), and the remnant floral parts attached to the fruit had staminodes present, verifying that it had been produced from a female rather than a bisexual flower. Male flowers have apparently well-developed ovules within an ovary of comparable size to that in female flowers. The fertility of these ovules is unknown, but the undeveloped styles would prevent self pollination in male flowers.

Variation within the new species

Leaves in the Mt Keith population are in the lower range of lengths recorded for this species (6–12 mm) and can be very small (≤ 5 mm long), and the shrubs are distinctly more divaricately branched than northern populations (Figure 3). Otherwise leaf morphological characters such as indumentum and shape match those of other populations of *S. picklesiana*. These Mt Keith populations occur on Archaean granite breakaways, and grazing pressure from local populations of euro (*Macropus robustus erubescens*) and/or black-footed rock-wallaby (*Petrogale lateralis*) is evident (Figure 3). Despite this, fruit and floral characters match those of other populations of *S. picklesiana*, and leaf size alone is insufficient evidence to segregate this as a distinct taxon. Populations from Mt Keith were found to be more likely to develop irregular fruits due to lack of fertilization of some of the ovules. Irregular development of fruits is a feature commonly associated with unisexual flowers (e.g. in *S. ectogama*, Barker 2007), but was not observed in northern populations of *S. picklesiana*. The fertilization of all mericarps suggests relatively good pollen transfer occurred within northern populations during the 2010 fruiting season.

Affinities

Sida picklesiana has clear affinities to *Sida* sp. Petermann Ranges (B.G. Thomson 2340), which is an informally named species from arid regions of Western Australia and the Northern Territory (Barker 2007) and which is currently being described by R.M. Barker and W. R. Barker (State Herbarium of South Australia, Department of Environment and Natural Resources). Both species possess small, mostly unisexual flowers and schizocarps of similar morphology. *Sida* sp. Petermann Ranges (B.G. Thomson 2340) is a variable species, and specimens from the Petermann Ranges have distinctly ovate, concolorous leaves, a glabrous staminal column, up to 5 flowers per axil, a calyx exceeding the fruit, distinct pedicels (2–8 mm in length) and are low, spreading woody shrubs (Barker 2007). Collections from the Pilbara (*K. Newbey* 10692, *S. van Leeuwen* 4377, *A.A. Mitchell* PRP1058) have markedly discolorous leaves reminiscent of *S. picklesiana*, but have longer pedicels (5–20 mm), a more lax, spindly habit and a sparse indumentum of stellate hairs on the staminal column.

Distinction of *Sida picklesiana* from similar species

The distribution of *Sida picklesiana* falls within that of other superficially similar species that are widespread through the Midwest region of Western Australia. It could be most easily confused with *S. ectogama*, *S. calyxhymenia* and *S. petrophila,* as all taxa have obovate to elliptic leaves, 5–7(8) mericarps, and a shrubby habit. These three species differ from *S. picklesiana* by their obviously pedicellate rather than subsessile flowers and calyx lobes which considerably exceed the fruit. The leaves of these three species have crenulate-serrulate margins, whereas leaf margins are entire in *S. picklesiana*. The leaf apices of *S. picklesiana* are more distinctly truncate and/or emarginate than in *S. ectogama*, *S. calyxhymenia* and *S. petrophila*. *Sida calyxhymenia* and *S. petrophila* can be distinguished from *S. picklesiana* by their bisexual flowers, concolorous leaves and an indumentum flecked with dark green stellate hairs (particularly on the calyx). *Sida ectogama* has unisexual flowers and discolorous leaves like *S. picklesiana*, but differs by its larger flowers (10–15 mm), notably ciliate and emarginate corolla lobes, a very short staminal column in male flowers, and distinctly elongate and exserted styles and stamens (Barker 2007). *Sida* sp. dark green fruit (S. van Leeuwen 2260) is a low, often sprawling and spreading shrub with narrowly oblong, discolorous leaves. It can easily be distinguished from *S. picklesiana* by its larger leaves, long-pedicellate (5–20 mm) rather than subsessile flowers and fruits, bisexual rather than unisexual flowers and 7–8(–10) rather than 5(6) styles and mericarps.

The *Sida* species key by Barker (2007) should be altered to read (from couplets 39 and 60):

39. Calyx inflated in fruit; flowers unisexual and stamens and styles well exserted from corolla; fruits with mericarps often developing unequally and remaining attached to each other for dispersal [spindly shrubs always growing under other vegetation; predominantly found in Murchison] .... **S. ectogama**

39: Calyx not inflated in fruit; flowers mostly bisexual but if unisexual stamens and styles just exserted from corolla; fruits with mericarps developing equally and detaching from each other for dispersal **39A**

39A. Flowers unisexual **39B**

39A: Flowers bisexual **40**

39B. Flowers pedicellate, in terminal leafless panicles. Tall spindly shrubs [watersheds of the Pilbara, Gascoyne and Great Sandy Desert; there are at least two taxa] .... **S.** sp. **spiciform panicles (E.Leyland s.n. 14/8/90)** *p.p.*

39B: Flowers subsessile, solitary in axils. Compact, densely branched shrubs [on exposed, rocky habitats, stony plains and near creeklines in the Cue, Wiluna, Meekatharra area] .... **S. picklesiana**

60. Flowers cymose or racemose [fruits smooth or somewhat corrugated, 3.5–6.5 mm diameter, deeply grooved between mericarps; mericarps 7 or 8, ± entire at apex; widespread and variable across Australia, undoubtedly containing a number of entities] .... **S. fibulifera**

60: Flowers solitary or paired **61**

61. Herbs, often prostrate, sprawling, not markedly woody; flowers bisexual; calyx enclosing fruit base and sides, not exceeding it **62**

61: Spreading woody shrub; flowers unisexual; calyx exceeding the fruit; corolla similar length to calyx; flowers usually unisexual **63**

62. Stipules lanceolate, 0.3–1.4 mm wide, buds 5–angled; leaves deeply crenate [some specimens from Cape Range and Dirk Hartog Island have been referred here in the past, but is likely that true *S. corrugata* does not occur in Western Australia] .... **S. corrugata**

62: Stipules filiform, to 0.2 mm wide; buds not 5–angled; leaves crenulate [Kimberley] .... **S. brachypoda** *p.p.*

63. Flowers distinctly pedicellate, pedicels 2–20 mm long, staminal column either with or lacking stellate hairs, sprawling subshrub to 20 cm high and up to 100 cm wide [Petermann Ranges only but with some outliers in the Pilbara showing a tendency to this species] .... **S.** sp. **Petermann Ranges (B.G. Thompson 2340)** *p.p*

63: Flowers subsessile, pedicels < 5 mm long, staminal column glabrous, densely branched rounded shrub to a metre or more high and wide [Gascoyne and Murchison regions] .... **S. picklesiana**

Acknowledgements

This work was mainly carried out at the Western Australian Herbarium, and we thank the following herbarium staff for their welcome support and assistance; Juliet Wege, Rob Davis, Kevin Thiele, Cheryl Parker and Karina Knight. We are grateful to Paul Wilson for the Latin diagnosis, and to Bill Barker (State Herbarium of South Australia) for his comments on *Sida* sp. Petermann Ranges (B.G. Thompson 2340) in relation to *S. picklesiana*. Both Simon Colwill (Western Botanical) and Feigh Sugg (Keith Lindbeck and Associates) helpfully provided site or voucher information. Many thanks are extended to David Pickles (DEC Kalgoorlie) for his interest in this taxon, and to both Kevin Thiele and an anonymous referee for critically reviewing the manuscript. BHP Billiton, Mt Keith

Operation is acknowledged for funding flora surveys at Mt Keith This research was supported by a *Specific Nature Conservation Project* grant (2010–2011) within the Nature Conservation Service.

References

Barker, R.M. (1998). A revised key to *Sida* section *Sida* in Australia, including a newly introduced species and name changes for *Sida rohlenae* var. *mutica* (Benth.) Fryxell and *S. magnifica* Domin. *Journal of the Adelaide Botanic Garden* 18: 33–41.

Barker, R.M. (2007). Two newly described species and a draft key to the species of *Sida s. lat.* from Western Australia. *Nuytsia* 17: 13–30.

Department of the Environment, Water, Heritage and the Arts (2008). *Interim Biogeographic Regionalisation for Australia* (*IBRA*), *Version 6.1.* http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html [accessed November 2010]

Fryxell, P.A. (1985). *Sidus sidarum* V – The north and central American species of *Sida*. *Sida* 11(1): 62–91.

Fryxell, P.A. (1987). *Sidus sidarum* VII – The genus *Sida* (Malvaceae) in Australia. *Sida* 12(1): 13–21.

Fuertes, J., Fryxell, P.A. & Jansen, R.K. (2003). Phylogenetic relationships and classification of the *Sida* generic alliance (Malvaceae) based on nrDNA ITS evidence. *Systematic Botany* 28(2): 352–364.

Gibson, N, Coates, D.J. & Theile K.R. (2007). Taxonomic research and the conservation status of flora in the Yilgarn Banded Iron Formation ranges. *Nuytsia* 17(1): 1–12.

Holland, A.E. & Reynolds, S.T. (1988). Five new species of *Sida* L. (Malvaceae) from Australia. *Austrobaileya* 2(5): 459–468.

Meissner, R., Owen, G. & Bayliss, B. (2009). Flora and vegetation of banded iron formations of the Yilgarn Craton: Cashmere Downs Range. *Conservation Science Western Australia* 7(2): 349–361.

Meissner, R., Owen, G. & Bayliss, B. (2009). Flora and vegetation of banded iron formations of the Yilgarn Craton: Mount Forrest–Mount Richardson Range. *Conservation Science Western Australia* 7(2): 377–389.

Markey, A.S., & Dillon, S.J. (2009). Flora and vegetation of the banded iron formations of the Yilgarn Craton: Herbert Lukin Ridge (Wiluna). *Conservation Science Western Australia* 7(2): 391–412.

Markey, A.S., & Dillon, S.J. (2010). Flora and vegetation of the banded iron formations of the Yilgarn Craton: the Booylgoo Range. *Conservation Science Western Australia* 7(3): 503–529.

Wege, J.A., Shepherd, K.A. & Butcher, R. (2007). Preface. *Nuytsia* 17.

Western Australian Herbarium (1998–). *Florabase – The Western Australian Flora*. Department of Environment and Conservation, http://florabase.dec.wa.gov.au/ [accessed March 2011]

Two species of *Inocybe* (fungi) introduced into Western Australia

Neale L. Bougher [1] and P. Brandon Matheny [2]

[1]Science Division, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
[2] Department of Ecology and Evolutionary Biology, 332 Hesler, University of Tennessee,
Knoxville, TN 37996–1610 USA
[1] Corresponding author, email: Neale.Bougher@dec.wa.gov.au

Abstract

Bougher, N.L. and Matheny, P.B. Two species of *Inocybe* (fungi) introduced into Western Australia. *Nuytsia* 21(3): 139–148 (2011). This paper reports for the first time the introduction into Western Australia from the northern hemisphere of *Inocybe curvipes* P.Karst. and *Inocybe rufuloides* Bon. The fungi are associated with planted non-native ectomycorrhizal trees – *Quercus*, *Pinus*, and possibly *Salix*. Previously, *I. curvipes* was confirmed from South Australia where it has been present for at least almost a century, but it was not known from Western Australia. *Inocybe rufuloides* had not been recorded anywhere in Australia. In this paper *I. curvipes* is also reported for the first time in Papua New Guinea, in association with planted *Quercus* and *Pinus*. *Populus* and *Quercus* are confirmed as ectomycorrhizal partners of *I. curvipes* based on ITS BLASTn analysis of environmental sequences.

Introduction

Numerous ectomycorrhizal macrofungi have been introduced from the Northern Hemisphere into Western Australia with their exotic plant associates. The most recent conspicuous introduction is the long anticipated first record of *Amanita muscaria* in Western Australia, in this case associated with *Betula pendula* (Robinson 2010). Eleven species of ectomycorrhizal fungi have been recognized in association with *Pinus* in Western Australia (Dunstan *et al.*, 1998). Some species of *Inocybe* are known to occur with planted *Pinus* in other regions of the Southern Hemisphere, but to date none have been reported in Australia (Dunstan *et al.* 1998; Walbert *et al.*, 2010). This paper reports and describes two introduced north temperate species of *Inocybe* previously unrecorded in Western Australia – *Inocybe curvipes* P. Karst., and *Inocybe rufuloides* Bon. *Inocybe curvipes* has been present in Australia for at least almost a century. This is indicated by some of the specimens in a mixed collection from South Australia in 1917 (associated plants not recorded) that recently were recognized for the first time as *Inocybe curvipes* by Matheny & Bougher (2010). *Inocybe rufuloides* had not been reported anywhere in Australia.

Methods

Fresh fruit bodies collected from the field were described following colour notations of Munsell Soil Color Charts (1954), Ridgway (1912), or Kornerup and Wanscher (1967) and then air-dried for later examination. Hand sections for microscopic observations were mounted in 3% KOH and in 1% Congo Red. Microscopic characters were drawn with a Nikon drawing tube system. Spore measurements include the hilar appendix and nodules.

DNA sequences of the internal transcribed spacer regions (ITS) and the 5' end of the nuclear large subunit ribosomal RNA region (nLSU) were produced following protocols outlined in Judge *et al.* (2009) and Matheny (2005). Seven new sequences (JN035289–JN035295) have been deposited at GenBank. The new sequences were used as queries of the NCBI nucleotide sequence database using the BLASTn search algorithm.

Taxonomic description

Inocybe curvipes P.Karst., *Hedwigia* 29: 176 (1890). *Type*: Tammela, Mustiala, Myllyperä, Finland, 22 August 1890, *P.A. Karsten s.n.* (*holo*: H 6025661).

Inocybe radiata Peck, *Bull. Torrey Bot. Club* 22: 488 (1895).

Inocybe lepidocephala Speg., *Anales Mus. Nac. Buenos Aires* 6: 126 (1898).

Inocybe variabillima Speg., *An. Mus. Nac. Bs. As.* 6: 125 (1899).

Inocybe decipientoides Peck, *Bull. Torrey Bot. Club* 34: 100 (1907).

Inocybe astoriana Murrill, *Mycologia* 3: 104 (1911).

Inocybe jamaicensis Murrill, *Mycologia* 4: 82 (1912).

Inocybe ochraceoscabra Atk., *Am. J. Bot.* 5: 214 (1918).

Inocybe globocystis Velen., *Ceské Houby*: 368 (1920).

Inocybe languinella (J.Schröt.) Konrad & Maubl., *Icon. Select. Fung.* 6: 137 (1937) *sensu auct. div., non* Konrad & Maubl.

Astrosporina decipientoides (Peck) Pearson, *Trans. Brit. Mycol. Soc.* 22: 28 (1938).

Inocybe cinerascentipes Huijsman, *Fungus* 25: 26 (1955).

Inocybe sericeopoda Furrer–Ziogas, *Beih. Sydowia* 10: 62 (1995).

Inocybe curvipes var. *globocystis* (Velen.) Bon, *Docs. Mycol.* 28 (109–110): 10 (1998).

[*Inocybe cicactricata auct. non* Ellis & Everh.: R.Heim, *Encylop. Mycol.*, 1 Le Genre *Inocybe* (Paris) 1: 351 (1931)].

[*Inocybe carpta auct. non* (Scop.:Fr.) P.Kumm.: Ricken, *Die Blätterpilze*: 101 (1915)].

[*Inocybe lanuginella auct. non* (J.Schröt.) Konrad & Maubl.: W.A.Dunstan, B.Dell & N. Malajczuk, *Mycorrhiza* 8: 73 (1998)].

Pileus to 27 mm diam., conical, hemispherical, or obtusely conical in youth, becoming subcampanulate, obtusely conical or more or less convex upon expansion, margin incurved when young, later decurved; velipellis absent, surface dry, appressed fibrillose with an unbroken center when young, later finely appressed scaly on and around the center and fibrillose towards the margin; margin torn and at times radially rimulose; dark brown (10YR 3/3) throughout or brown (10YR 4/3) or shading brown towards the margin, at times the edge of the margin is yellowish brown (10YR 5/4) – 'Mummy Brown' to 'Bister'to 'Snuff Brown', shading to 'Snuff Brown', 'Saccardo's Umber' to 'Tawny-Olive' towards the margin; context pallid or white, not changing color where bruised. *Lamellae* adnate to adnexed, moderately close, 34–48 L with several tiers of lamellulae, ventricose in age, up to 4 mm broad; light gray when immature to light yellowish brown or brown, eventually dark yellowish brown in age; edges pallid and fimbriate. *Stipe* 20–40 mm × 3–7 mm at apex, even or with a slightly swollen base; cortina fugacious, surface nowhere pruinose, finely–fibrillose to fibrillose or twisted fibrillose, generally pallid above shading to light brown or 'Avellaneous' below, but brown to dark brown or 'Bister' at the base and upwards in age; context solid, mostly pallid, at times with subtle pinkish brown cortex. Odour spermatic when first cut, later mixed with an acidulous component. Taste not recorded. Spore deposit not recorded.

Basidiospores (8.5) 9–12 × 5–6.5 µm, mean 10.3 × 5.6 µm, mean profile 10.3 × 5.6 µm (n= 30), mean face view 9.9 × 5.7 µm (n= 30), mean L/B ratio profile 1.82, mean L/B ratio face view 1.75, gibbous about a trapeziform outline with 6–10 moderate to small-sized nodules to 2 µm tall, at times these merely corners, usually with a distinct apical nodule, yellowish brown, apiculus distinct. *Basidia* 26–34 × 8–11 µm, predominantly quadrisporic, but also sometimes bisporic and monosporic then with long sterigmata to 15 µm, clavate, cylindric or ventricose (particularly when mono- and bi-sporic). *Lamellae trama* of parallel hyphae –12 µm wide, with similar but narrower hyphae in the subhymenium. *Pleurocystidia* 47–73 × 19–27 µm, broadly fusiform or saccate and noticeably tapered towards the apex, this usually acute (not obtuse or well-rounded) and crystalliferous, with a slender, long basal pedicel (e.g. 12 × 5µm) ; thick-walled, walls to 2.5 µm thick, hyaline. *Cheilocystidia* 48–66 × 15–24 µm similar to pleurocystidia but more variable in shape with abundant small clavate and vesiculose paracystidia among the larger cystidia. *Stipitipellis* with no caulocystidia; sparse vesture hyphae observed on lower part of the stipe. *Pileipellis* a cutis of cylindric hyphae 4–15 µm wide, many with brown encrusting pigment, some emerging in scattered bundles and with cystidioid terminal elements e.g. lageniform 51 × 4 µm. *Clamp connections* present in all tissues. (Figures 1, 2)

Specimens examined. WESTERN AUSTRALIA: Carine, Perth, gregarious on soil under *Quercus* in suburban backyard garden, 31 Aug. 2001, *B. Dunstan PBM* 2210 (PERTH 007676859, formerly CSIRO E7058); Botany Department, campus of University of Western Australia, Crawley, Perth, in rose garden, 6 June 1973, *D. Waldie s.n.* (PERTH 00763578). AUSTRALIAN CAPITAL TERRITORY: Black Mountain CSIRO, Canberra, in grass at base of *Pinus radiata* near the herbarium, 14 Feb. 1990, *E. Cooper EC* 4 (CANB 404918, ITS and LSU sequences respectively: JN035289, JN035293). SOUTH AUSTRALIA: Belair National Park, unrecorded habitat and plant association, 12 May 1917, *J. B. Cleland s.n.* (AD12143). VICTORIA: Templestowe, Melbourne, growing in lawn in rings under weeping willow (presumably *Salix*), 29 May 1963, *P. Jenkins s.n.* (MEL 1054882). PAPUA NEW GUINEA: near Massy, along road under *Pinus*, 27 July 2003, *R. Treu* TR37–03 (M–0138268, ITS and LSU sequences respectively: JN035290 and JN035294). JAMAICA: Cinchona, wet mountains area, 4500–5200 ft elev, in a clay road, collected between 25 Dec. 1908 and 8 Jan. 1909, *W.A. Murrill & E.L. Murrill* WAM & ELM 595 (WTU, isotype of *Inocybe jamaicensis* Murrill). UNITED STATES OF AMERICA: Massachusetts, in open grassy ground, Aug. and Sep., *W.D. Jackson (*WTU, isotype of *Inocybe radiata* Peck); Washington, next to Burke–Gilman Trail near the Wall of Death, University District, Seattle, on disturbed soil along side of road near *Corylus*, *Prunus*, and *Populus*, 18 June 1998, *P.B. Matheny* PBM1007 (WTU); on grassy lawn under introduced *Arbutus unedo* with *Pinus* in the vicinity, 28 Oct. 1998, *P.B. Matheny* PBM 1328 (WTU); Green Lake, Seattle, King County, on ground under *Betula*, 15 Sep. 2002, *J.F. Ammirati & M.T. Seidl* PBM 2401 (WTU).

Distribution and habitat. On soil under introduced *Quercus* or *Pinus radiata*, and possibly *Salix*, introduced into Western Australia, Australian Capital Territory, South Australia, Victoria, and Papua New Guinea. Fruiting February, May to August (in Australia).

Notes. Inocybe curvipes is distinctive microscopically by its broadly fusiform hymenial cystidia that are tapered at the acute apex (Figures 2C, 2D), and its long spores with 6–10 moderate to small-sized nodules or merely corners (Figure 2A). The presence of monosporic and bisporic basidia (Figure 2B) is not a consistent feature of this species but they are present in some collections from Australia and elsewhere. They occur in only one of the two Western Australian collections examined (PERTH 07676859). *Inocybe curvipes* has a restricted habitat in Australia as it occurs in gardens and suburban plantings of *Quercus* or *Pinus* or possibly *Salix*. It has not been found in natural vegetation or in exotic plantations of *Pinus* in Australia. We previously recognized this species for the first time in Australia – from South Australia (Matheny & Bougher 2010), but it had not been reported in other parts of Australia or in Papua New Guinea.

BLASTn results of our *I. curvipes* ITS sequences reveal 16 matches (97–99% similarity) with unidentified environmental sequences from ectomycorrhizas of *Populus* in plantations (Stefani *et al.* 2009), two matches (99% similarity) with *Quercus* ectomycorrhizas from a nursery setting (Leski *et al.* 2010), two Swedish isolates labeled *I. curvipes* (99% similarity), and one Estonian isolate labeled *I. cf. rennyi* (99% similarity) (Ryberg *et al.* 2008). These data unequivocally confirm *I. curvipes* as an ectomycorrhizal associate of *Populus* and *Quercus* in plantation and nursery settings outside Australia. The high similarity with the isolate labeled *I.* cf. *rennyi* is noteworthy because presumably the collection from which the sequence was obtained must feature the unusually elongated spores typical of *I. rennyi* (Kropp & Matheny 2004). Evidence is mounting that either *I. rennyi* represents a polyphyletic taxon, or is at least merely an aberrant spored version of *I. curvipes*. ITS sequences of collections from the ACT and Papua New Guinea differ at three sites, two of which are polymorphic in the ACT collection.

Inocybe curvipes has been present in Australia for at least almost a century. A collection of it from South Australia (AD12143) was made by J. B. Cleland in 1917. That collection was originally unidentified by Cleland, and later incorporated together with *Asterosporina asterospora* sensu Cleland and merged into the protologue of *Inocybe dewrangia* Grgur. (Grgurinovic 1997, Matheny & Bougher 2010). *Inocybe curvipes* was likely introduced into Australia and Papua New Guinea together with imported north temperate ectomycorrhizal plants such as *Quercus* and *Pinus* species. It has been similarly introduced into other southern hemisphere regions, e.g. *I. curvipes* (as *I. lanuginella*) is recorded as an ectomycorrhizal fungus associated with *Pinus* in South Africa (Dunstan *et al.*, 1998). It is also widespread in South America under *Pinus* (Cortez & Coelho 2005).

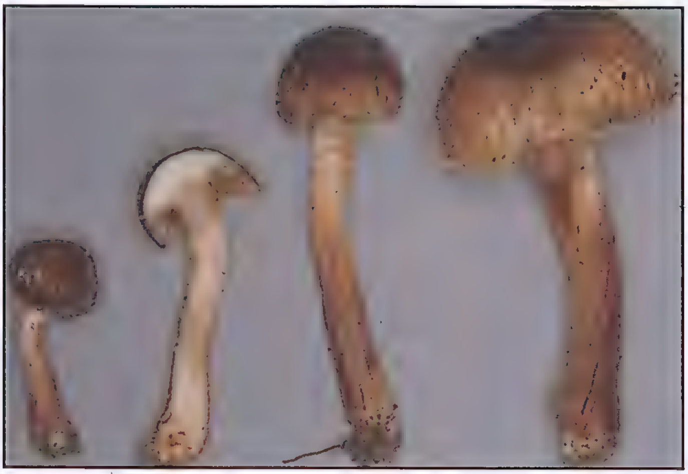


Figure 1. Basidiomes of *Inocybe curvipes* (PERTH 007676859).

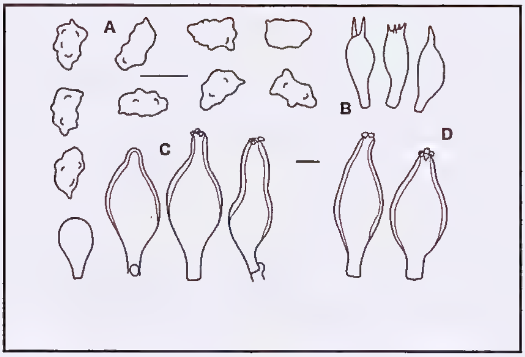


Figure 2. Micromorphology of *Inocybe curvipes* (PERTH 007676859). A – spores; B – basidia; C – cheilocystidia; D – pleurocystidia. Scale bars = 10 µm (longer bar for spores only).

Inocybe curvipes is a toxic species that can be expected to occur in urban or suburban habitats of non–native, north temperate ectomycorrhizal trees. While revising collections of *Inocybe* at MEL in Melbourne, we identified one from the 1960s as *I. curvipes* (originally identified as *Inocybe* sp. – MEL1054882), which was annotated with the words "cause of muscarin poisoning in woman who gathered it to eat it in mistake for mushroom".

Inocybe curvipes is widespread in the northern hemisphere temperate zone having been described numerous times in Europe, eastern and western North America, and Central America. As is the case with many other Inocybaceae, *I. curvipes* has been misidentified numerous times since it was originally published in 1890 by Karsten; for example, two eminent American mycologists, C. H. Peck and W. A. Murrill, both subsequently published this species under two different newly proposed names (see synonymy above). Kauffman (1924) reported *I. ochraceoscabrosa* Atk. as a synonym of *I. decipentoides*, both of which are later synonyms of *I. curvipes* (Stangl 1989). Our list of synonyms follows Stangl (1989), to which we add the following: *I. radiata* Peck and *I. jamaicensis* Murrill based on studies of the types. Stangl's list of synonyms of *I. curvipes* follows much of Singer (1949), who reported the following species as synonyms of *I. decipientoides*: *I. astoriana* Murrill, *I. ochraceoscabrosa* Atk., *I. globocystis* Velen. as reconfirmed by Kuyper (1985), *I. carpta* (Scop.: Fr.) Sacc sensu Ricken, and later in the same publication *I. variabillima* Speg. We also list *I. sericeopoda* Furrer–Ziogas as a synonym of *I. curvipes* based on the figures depicted in Furrer–Ziogas (1995) and in line with the synonymy presented in Esteve–Raventós & Caballero (2009); however, we have not examined the type, which is indicated in a private herbarium.

Inocybe cicatricata sensu R. Heim (1931; Fig. 202) is *I. curvipes*, no doubt, given the morphology of the cystidia depicted in Heim's drawings. Stuntz (1947) separated *I. cicatricata* from *I. decipientoides* and his line drawings bear out their separation; however, Stuntz states that his material of *I. cicatricata* '... agrees quite well with Heim's description of *Inocybe cicatricata* Ellis & Ev.' *Inocybe cicatricata* sensu Stuntz (1947), however, in our opinion is not *I. curvipes*.

Inocybe rufuloides Bon, *Docums. Mycol.* 14 (53): 28 (1984). *Type*: Cayeux-sur-Mer (Somme), France, 19 May 1983, *Bon, Vast & Claus s.n.* (*holo*: MB 83038).

Pileus 5–35 mm diam.; convex to hemispherical in button, then conico-campanulate, maintaining a broad central umbo and not or very reluctantly expanding to applanate in old age; margin plane at first with evanescent whitish appendiculate (suggestive of a partial veil); surface dry radially fibrillose with appressed pale silvery appressed fibrils some fusing into narrow appressed squamules, centre of pileus more matted-fibrillose, overlying the mousey brown (near 6E4) to dull bronze-brown (near 6E5) then later darker brown (near 7F8) pileal surface; context dull cream, paler in cap, up to 5 mm thick above stipe apex. Partial veil: sparse, rapidly evanescent whitish fibrils. *Lamellae* broadly adnexed, slightly ventricose, to 7 mm deep, crowded then closely spaced with abundant lamellulae in three tiers; edge minutely cystidiate (but not conspicuous to the eye), edge paler or concolorous with face, pale cream in button, then pale fawn (near 5B4), finally dull brown (near 5D6–6D6) or dull greyish brown (near 6D4) never dark or rusty brown. *Stipe* to 50 × 8 mm; cylindric with base slightly swollen or clavate; solid; surface longitudinally silky-fibrillose with whitish appressed fibrils over entire length (easy to remove on handling), fibrils breaking up into minute floccules near apex, but no pruinosity present; dull whitish with slight pinkish tinge especially towards the apex in some specimens, darker and dull when old. *Basal mycelium* white but not copious or conspicuous. *Odour* grassy, spermatic. *Taste* not recorded. Spore deposit dark brown (near 6F5–6F6 to 7F6).

Basidiospores 11–12.5 (13) × 5.5–6.5 µm, mean 11.3 × 6.1 µm, mean profile 11.3 × 6.1 µm (n= 30), mean face view 11.4 × 6.1 µm (n= 30), mean L/B ratio profile 1.85, mean L/B ratio face view 1.87, smooth, ellipsoid to ovoid in face view, ovoid to subamygdaliform in profile sometimes with slight adaxial depression, with slightly thick wall, yellowish brown, apiculus small but prominent. *Basidia* 25–37 × 8.5–11.5 µm, quadrisporic, clavate to narrowly ventricose, hyaline. *Lamellae trama* of parallel clamped hyphae to 16 µm wide, subhyenium of narrower hyphae 2–4 µm wide. *Pleurocystidia* 53–75 × 14–17 µm, lageniform, subfusiform or utriform, crystalliferous; thick-walled, walls to 2 µm thick, hyaline. *Cheilocystidia* 20–56 × 11–15.5 µm, similar to pleurocystidia, crowded forming sterile lamella edge, thin-walled paracystidia sometimes in short chains. *Stipitipellis* with few caulocystidia similar to the hymenial cystidia at the stipe apex, end cells otherwise undifferentiated. *Pileipellis* a cutis of cylindric hyphae to 10 µm wide, many with brown encrusting pigment, subpellis not well differentiated but with more tightly packed hyphae. *Clamp connections* present in all tissues. (Figures 3, 4)

Specimens examined. WESTERN AUSTRALIA: Modong Nature Reserve, Jandakot Regional Park, Thomas Rd, Oakford, Perth, in gregarious troops in disturbed gravelly roadside edge near *Pinus* plantation with *Melaleuca preissiana* and *Adenanthos* sp. also present, 9 July 2006, *N. Bougher, N. Goldsborough & J. Keeble* E8353 (PERTH 07700598 (ITS and LSU sequences respectively: JN035292, JN035295); Bold Park, Perth, abundant in litter under *Pinus radiata* trees, adjacent to Ecology Centre, just South of Oceanic Drive, 10 July 2008, *N. Bougher* 00479 (PERTH 08073147); Bold Park, Perth, same location, 1 June 2010, *N. Bougher* 00618 (PERTH 08305978)(ITS sequence: JN035291); Bold Park, Perth, abundant along edge of limestone track in banksia woodland with *Pinus radiata* plantation nearby (30 m to nearest pine tree), Bold Park's central pine plantation, 29 July 2009, *N. Bougher* 00541 (PERTH 08305951).

Distribution and habitat. On soil, often in abundance, under planted *Pinus radiata*, introduced to Western Australia. Fruiting June to July.

Notes. Inocybe rufuloides can be recognized in Western Australia by its occurrence in pine plantations together with a combination of features including its dull bronze-brown, radially fibrillose pileus with some whitish overhanging fibrils when young, pale lamellae, pinkish upper stipe, and grassy/spermatic odour (Figure 3). It has smooth, ellipsoid to subamygdaliform spores, and metuloid cheilocystidia and pleurocystidia (Figure 4). *Inocybe rufuloides* is an ectomycorrhizal associate of *Pinus* species in Europe, e.g. *Pinus pinea* (Iotti *et al.* 2005). Collections of *I. rufuloides* from France listed by Bon (1984) in his original description indicate a possible association with *Pinus* and other plants such as *Picea*. In Western Australia *I. rufuloides* is an exotic species apparently exclusively associated with *Pinus*, and it is not yet known to associate there with other plants.

We identify the Western Australian collections cited above as *Inocybe rufuloides* in view of their conformity with the range of attributes presented in the literature for that species, and sequence similarity with material identified by J. Vauras as *I. rufuloides* (Ryberg 2009). Vesper and Richter (2010) present a comparison of their morphological data for *I. rufuloides* against data published by eight other authors. The Western Australian material conforms within the range of attributes presented, but the attributes presented show considerable variation. For example, caulocystidia are variably considered absent or present by the authors listed by Vesper and Richter (2010). The Western Australian collections have very few differentiated terminal cells on the stipe surface, with only some cauloparacystidia (broad shape, not or barely thick–walled) and rare metuloid caulocystidia (we observed only one metuloid in samples from 3 fruit bodies in each of 3 different collections). Further evidence pointing to morphological variability in *I. rufluoides* is that the Western Australian collections are much less reddish–brown overall than for specimens shown in the image of *I.* aff. *rufuloides* by Vesper and Richter (2010).

Iotti *et al.* (2005) reported that *I. rufuloides* is one of two *Inocybe* species found contaminating *Tuber* infected plants in experimental truffières in Italy. However, the identity of their material is called into question given that a BLASTn search of DQ067579 (sequence generated from a sporocarp) shows it to be highly similar (98% similarity) to *I. pseudodestricta* Stangl & J. Veselský, FN550908, based on material identified by J. Vauras. BLASTn searches of Western Australian *I. rufuloides* match a sequence produced by Ryberg (2009), using material from Italy identified by J. Vauras as *I. rufuloides*.

The gross morphology of *Inocybe pseudostricta* as described by Stangl and Veselský (1973) is indeed similar to that of the Western Australian collections, including having a pale brownish stipe that is reddish along the upper third. However, the protologue for *I. pseudodestricta* by Stangl and Veselský (1973) shows at least two significant microscopical attributes that differ from the Western Australian collections: (1) more strongly amygdaliform spores lacking the adaxial flattening or depression present on the spores of Western Australian collections; (2) presence of long, narrow caulocystidia.

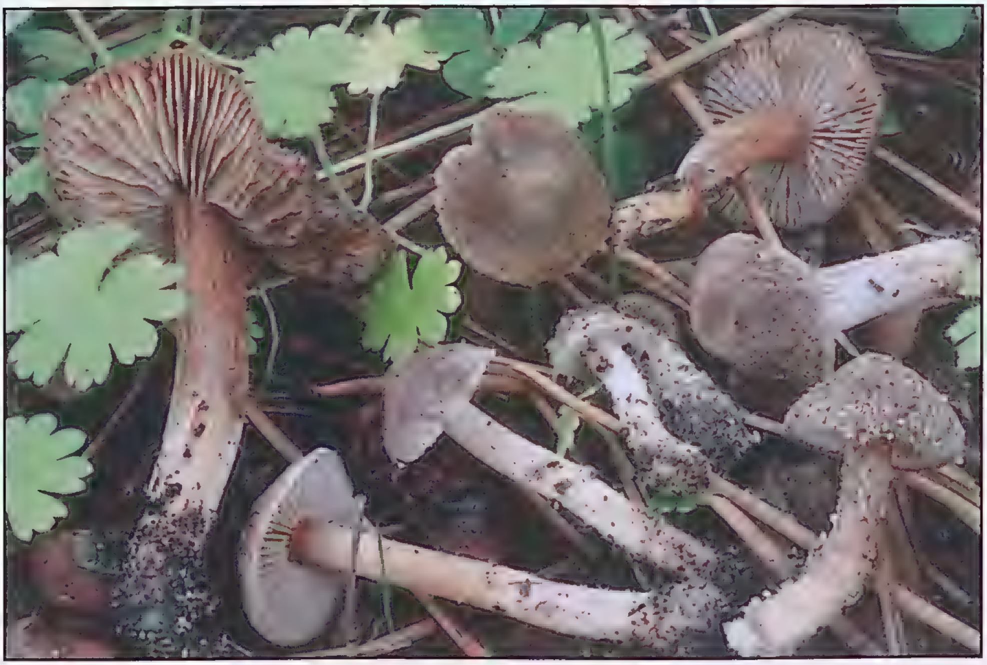


Figure 3. Basidiomes of *Inocybe rufuloides* (PERTH 08073147).

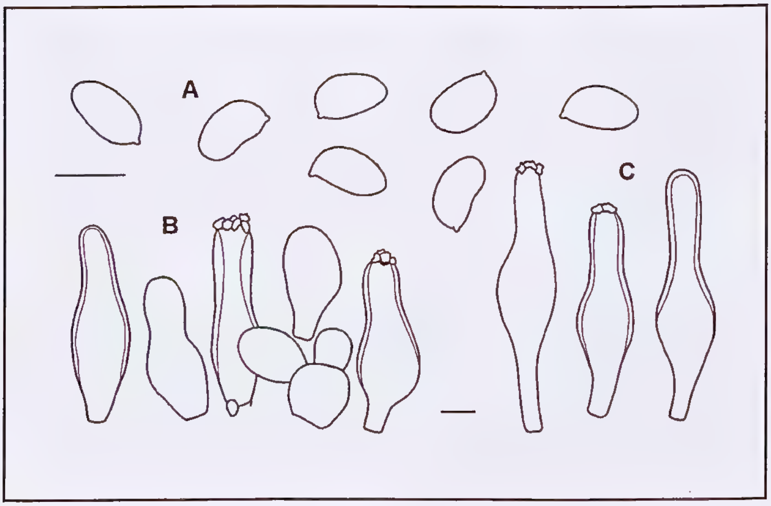


Figure 4. Micromorphology of *Inocybe rufuloides* (PERTH 08073147). A – spores; B – cheilocystidia; C – pleurocystidia. Scale bars = 10 μm (longer bar for spores only).

Acknowledgements

Our thanks to Dr. Pertti Salo at the Finnish Museum of Natural History for providing us with collection data for the type of *Inocybe curvipes*. We thank Dr. Tom May at the National Herbarium of Victoria for retrieving the collection data and annotations for MEL1054882. We also appreciate herbarium loans from Roland Treu and staff at the Botanische Staatssammlung München (M) and the Australian National Herbarium, Canberra (CANB). Examination of type materials was done at the University of Washington Herbarium (WTU). Both authors acknowledge financial support from the Office of Research and the College of Arts & Sciences at the University of Tennessee, and a research grant from the U.S. National Science Foundation (DEB–0949517). Also we acknowledge a research grant from the Australian Government's Australian Biological Resources Study National Taxonomy Research Grant Program (RFL211–31), and financial support from the Western Australian Naturalists' Club Inc.

References

Bon, M. (1984). Macromycetes de la zone maritime picarde. Les Inocybes sabulicoles. *Documents Mycologiques* 14: 9–40.

Cortez, V.G. & Coelho, G. (2005). Additions to the mycobiota (Agaricales, Basidiomycetes) of Rio Grande do Sul, Brazil. *Iheringia Série Botanica* 60: 69–75.

Dunstan, W.A., Dell, B. & Malajczuk, N. (1998). The diversity of ectomycorrhizal fungi associated with introduced *Pinus* spp. in the southern hemisphere, with particular reference to Western Australia. *Mycorrhiza* 8: 71–79.

Esteve–Raventós, F. & Caballero, A.M. (2009). Especies nuevas e interesantes del género Inocybe (1). *Fungi non delineati* 47: 1–128.

Furrer–Ziogas, C. (1995). *Inocybe sericeopöda sp. n. Beihefte Sydowia* 10: 62–66.

Grgurinovic, C.A. (1997). *Larger fungi of South Australia.* (Botanic Gardens of Adelaide and State Herbarium: Adelaide.)

Heim, R. (1931). Le Genre *Inocybe. Encylopédie Mycologique I*: 1–429.

Judge, B.S., Ammirati, J.F., Lincoff, G.H., Trestrail, J.H. & Matheny, P.B. (2009) Ingestion of a newly described North American mushroom species from Michigan resulting in chronic renal failure: *Cortinarius orellanosus. Clinical Toxicology* 48: 545–549.

Iotti, M., Marchetti, M., Bonuso, E. & Zambonelli, A. (2005). Morphological and molecular characterization of the mycorrhizas of *Inocybe rufuloides* and *I. splendens. Mycotaxon* 94: 75–84.

Kauffman, C.H. (1924). *Inocybe. In: North America flora.* Vol. 10, pt. 4, p. 227–260 (New York Botanical Garden: New York.)

Kornerup, A. & Wanscher, J.H. (1967) *Methuen handbook of colour*. 2nd edn. (Methuen:London).

Kropp, B.R. & Matheny, P.B. (2004). Basidiospore homoplasy and variation in the *Inocybe chelanensis* group in North America. *Mycologia* 96: 295–309.

Kuyper, T.W. (1985). Studies in *Inocybe*—I. Revision of the new taxa of *Inocybe* described by Velenovsky. *Persoonia* 12: 375–400.

Leski, T., Pietras, M. & Rudawska, M. (2010). Ectomycorrhizal fungal communities of pedunculate and sessile oak seedlings from bare–root forest nurseries. *Mycorrhiza* 20:179–190.

Matheny, P.B. (2005). Improving phylogenetic inference of mushrooms using RPB1 and RPB2 sequences (*Inocybe*; Agaricales). *Molecular Phylogenetics and Evolution* 35: 1–20.

Matheny, P.B., & Bougher, N.L. (2010). Type studies of *Inocybe* from Australia. *Muelleria* 28: 87–104.

Munsell Color Company (1954). Munsell soil color charts. (Munsell Color Company: Baltimore, Md.)

Ridgway, R. (1912). *Color standards and color nomenclature.* (The Author: Washington, D. C.)

Robinson, R. (2010). First record of *Amanita muscaria* in Western Australia. *Australasian Mycologist* 29: 4–6.

Ryberg, M. (2009). *An evolutionary view of the taxonomy and ecology of Inocybe (Agaricales) with new perspectives gleaned from GenBank metadata.* PhD dissertation, University of Gothenburg, Department of Plant and Environmental Sciences.

Ryberg, M., Nilsson, R.H., Kristiansson, E., Topel, M., Jacobsson, S. & Larsson, E. (2008). Mining metadata from unidentified ITS sequences in GenBank: a case study in *Inocybe* (Basidiomycota). *BMC Evolutionary Biology* 8: 50.

Singer, R. (1949). The 'Agaricales' (mushrooms) in modern taxonomy. *Lilloa* 22: 5–832.

Stangl, J. (1989). Die Gattung *Inocybe* in Bayern. *Hoppea* 46: 5–388.

Stangl, J. & Veselský, J. (1973). Zweiter beitrag zur kenntnis der selteneren *Inocybe* –Arten. Česká Mykologie 27: 11–25.

Stefani, F.O.P., Moncalvo, J.–M., Sequin, A., Berube, J.A. & Hamelin, R.C. (2009). Impact of an 8–year–old transgenic poplar plantation on the ectomycorrhizal fungal community. *Applied and Environmental Microbiology* 75: 7527–7536.

Stuntz, D.E. (1947). Studies in the genus *Inocybe*. I. New and noteworthy species from Washington. *Mycologia* 39: 21–55.

Vesper, A. & Richter, T. (2010). Studien zu zwei wenig bekannten risspilzen, *Inocybe rufuloides* und *I. subporospora*. *Boletus* 32: 100–105.

Walbert, K., Ramsfield, T.D., Ridgway, H.J. & Jones, E.E. (2010). Ectomycorrhizal species associated with *Pinus radiata* in New Zealand including novel associations determined by molecular analysis. *Mycorrhiza* 20: 209–215.

SHORT COMMUNICATIONS

Re-evaluation of some infraspecific taxa in *Ptilotus* (Amaranthaceae)

This short communication is a continuation of work evaluating infraspecific taxa in Western Australian *Ptilotus* R.Br. (Davis 2009; Davis & Butcher 2010a, 2010b) for the forthcoming *Flora of Australia* treatment of Amaranthaceae. After examining the type of *Ptilotus grandiflorus* F.Muell. var. *lepidus* (F.Muell.) Benth. (= *P. lepidus* F.Muell.) from MEL and collections of *P. grandiflorus sens. lat.* at PERTH, it is apparent that *P. grandiflorus* var. *lepidus* does not have taxonomic merit and should be synonymised under *P. grandiflorus*. Conversely, after examining the infraspecific taxa of *P. humilis* (Nees) F.Muell. it is clear that *P. humilis* var. *parviflorus* Benth. warrants the rank of species. It is here elevated as *P. parviflorus* (Benth.) R.W.Davis.

Taxonomy

Ptilotus grandiflorus F.Muell., *Fragm.* 1: 237 (1859). *Type*: Ad flumen Murchison, *A. Oldfield s.n.* (*holo*: MEL 1058701, image seen).

Ptilotus lepidus F.Muell., *Fragm.* 4: 89 (1864); *Ptilotus grandiflorus* F.Muell. var. *lepidus* (F.Muell.) Benth., *Fl. Austral.* 5: 243 (1870). *Type*: near Shark Bay, W.A., *M. Brown s.n.* (*holo*: MEL!).

Prostrate or ascending *herbs*, to 30 cm high. *Stems* ribbed, sparsely hairy to glabrous, with nodose hairs. *Basal leaves* oblanceolate, 30–80 mm long, 2–10 mm wide, sparsely hairy to glabrous, with nodose hairs. *Cauline leaves* alternate, oblanceolate, 5–40 mm long, 1–10 mm wide, sparsely hairy to glabrous, with nodose hairs. *Inflorescences* terminal, solitary or clustered, pink or white, ovoid to cylindrical, 10–35 mm long, 14–23 mm diam.; *bracts* narrowly ovate, translucent, 4.4–5.5 mm long, glabrous, apex slightly apiculate, with an obscure midrib; *bracteoles* narrowly ovate to obovate, translucent, 4.4–5.3 mm long, glabrous, apex slightly apiculate, with an obscure midrib. *Flowers* pedicellate; *outer tepals* pink to white, (5)6–10.5 mm long, puberulent except at the very base, sericeous at base, with nodose to subverticillate hairs, apices truncate to rounded, serrated; *inner tepals* with a basal tuft of hairs on inner surface; *staminal cup* 0.9–1.1 mm long; *stamens* 5; *ovary* glabrous; *style* slightly curved to straight, central to sub-centrally fixed to ovary, 1.1–1.2 mm long. *Seed* not seen.

Selected specimens. WESTERN AUSTRALIA: 250 m N of the Greenough River on W boundary of East Yuna Reserve, 15 Nov. 1997, *P.G. Armstrong s.n.* (PERTH); between Hamelin Pool and Shark Bay, Aug. 1940, *W.E. Blackall* 4582 (PERTH); 9 km N of Nerren Nerren rest area on North West Coastal Highway, 16 Oct. 2005, *G. Byrne* 1735 (PERTH); 6 km SSE of Meegea Hill, Milly Milly Station, 9 May 1995, *R.J. Cranfield* 9751 (PERTH); 56 km W of Mullewa on Yalgoo Road, 15 Oct. 1996, *B.A. Fuhrer* 96/35 (MEL, PERTH); Coolcalalaya Road, Northampton, 22.9 km NE of North West Coastal Highway, 5 Oct. 2004, *F. Hort, J. Hort & J. Shanks* 2331 (PERTH); Perenjori Hills, 13 Oct. 2005, *R. Meissner & Y. Caruso* 368 (PERTH); 16 km W of Barnong turnoff on the Mullewa to Yalgoo Road, 20 Oct. 2003, *L. Sweedman* 6198 (PERTH); Yuna Nature Reserve, 1.3 km from the west end of Campbells Road, 28 Sep. 2007, *M.E. Trudgen & M. Guest* MET 22546 (PERTH).

Distribution and habitat. Ptilotus grandiflorus occurs in near-coastal areas from Shark Bay to Geraldton, stretching inland to Kalgoorlie in the south-east of its range and to Meekatharra in the north-east. Often found in *Acacia* scrublands and open *Eucalyptus* woodlands, usually growing on red sand or sandy loams.

Notes. Although Mueller (1859, 1864) described both *Ptilotus grandiflorus* and *P. lepidus* he gave no indication of the differences between these taxa, saying only that they were somewhat similar. Bentham (1870) regarded tepal length to be the only morphological difference between *P. grandiflorus* and *P. lepidus* (4–5 lines long, *c*. 8–10 mm long, in *P. grandiflorus* and to 3 lines long, *c*. 6 mm long, in *P. lepidus*). He therefore reduced *P. lepidus* to a variety of *P. grandiflorus*.

Examination of the type of *P. lepidus* (=*P. grandiflorus* var. *lepidus*) found that tepal size has a greater measurement range than previously given by Bentham, ranging from 5.5–7.5 mm long. Based on the specimens currently held at PERTH, tepal lengths in *P. grandiflorus sens. lat.* were found to vary from 6–10.5 mm long. Given that tepal size can vary due to seasonal effects, that tepal lengths overlap between the varieties, and that there are no other discernable morphological or quantitative differences between them, it is concluded here that *P. grandiflorus* var. *lepidus* should not be recognised as a distinct taxon and it is therefore synonymised under *P. grandiflorus*.

Ptilotus parviflorus (Benth.) R.W.Davis, *stat. et comb. nov.*

Ptilotus humilis (Nees) F.Muell. var. *parviflorus* Benth., *Fl. Austral.* 5: 245 (1870). *Type*: S.W. Australia, 1860, *Mr Burges s.n.* (*holo*: K 000356830, image seen).

Ptilotus humilis (Nees) F.Muell. subsp. *parviflorus* (Benth.) Benl ms, *nom. inval.*

Prostrate *herbs*, to 6 cm high. *Stems* glabrous or sparsely hairy, with crisped nodose hairs. *Basal leaves* oblanceolate, 10–40 mm long, 1–5 mm wide, glabrous or sparsely hairy, with nodose hairs. *Cauline leaves* alternate, oblanceolate or obovate, 5–40 mm long, 1–3 mm wide, glabrous or sparsely hairy, with nodose hairs. *Inflorescences* terminal, solitary or sometimes clustered, white-green with pink tinge, ovoid to cylindrical, 5–25 mm long, 8–10 mm diam.; *bracts* ovate, translucent, 3.5–4 mm long, glabrous or hairy, attenuate at apex, with an obscure midrib; *bracteoles* ovate, translucent, 3.5–4 mm long, glabrous, attenuate at apex, with an obscure midrib. *Flowers* pedicellate; *outer tepals* white-green with pink tinge along medial section, 3.8–4.5 mm long, with sparse, silky, verticillate hairs on lower half, puberulent on the distal half, hairs simple, apices truncate to slightly rounded, serrated; *inner tepals* with a basal tuft of hairs on inner surface; *staminal cup* 0.5–0.8 mm long; *stamens* 5; *ovary* glabrous; *style* straight, centrally fixed to ovary, 0.6–0.9 mm long. *Seeds* glossy, brown, 0.7–0.9 mm long.

Selected specimens. WESTERN AUSTRALIA: Mount Manning Range, 12 Sep. 1980, *A.A. Burbidge* 203 (PERTH); SE of Coolcalalaya Station, 13 Oct. 1988, *A.H. Burbidge* 4246 (PERTH); *c*. 4.4 km SSE of North West Peak, Mount Manning Range, 3 Nov. 1995, *N. Gibson & B. Moyle* 3387 (PERTH); Drages Paddock, 4 km E of Woolgorong homestead, 17 Sep. 1996, *M. Officer* MO 138 (PERTH); Woolgorong Homestead, 29 Aug. 1995, *M. Officer* MO 98 (PERTH).

Distribution and habitat. Ptilotus parviflorus is relatively poorly collected and is only known from disjunct populations north and north-east of Geraldton, and to the far south-east at Mount Manning

Range. It grows in scrublands on sandy or sandy-clay soils. The distributions of the widespread *P. humilis* and *P. parviflorus* overlap in the Geraldton region, however, no intermediates have been observed.

Notes. Although *Ptilotus parviflorus* is superficially similar to *P. humilis*, on close inspection there are obvious and significant floral differences between them. For example, in *P. parviflorus* the tepals are 3.8–4.5 mm long with a sparse, silky indumentum of verticillate hairs, the bracteoles are ovate, the ovary and style are slender and 0.6–0.9 mm long, and the seeds are globose. By comparison, in *P. humilis* the tepals are 5–7.7 mm long with a much longer, denser, woolly indumentum of verticillate hairs, the bracteoles are orbicular, the ovary and style are stouter and 0.4–0.6 mm long, and the seeds are ovoid.

References

Bentham, G. (1870). *Flora Australiensis.* Vol. 5, p. 243. (Reeve: London.)

Davis, R.W. (2009). *Ptilotus luteolus*, a new combination in *Ptilotus* (Amaranthaceae). *Nuytsia* 19: 311–312.

Davis, R.W. & Butcher, R. (2010a). Re-evaluation of *Ptilotus polystachyus sens. lat.* (Amaranthaceae) and creation of the new combination *Ptilotus giganteus*. *Nuytsia* 20: 217–227.

Davis, R.W. & Butcher, R. (2010b). The status of infraspecific taxa and new subspecies in *Ptilotus stirlingii* (Amaranthaceae). *Nuytsia* 20: 261–270.

Mueller, F. von. (1859). *Fragmenta phytographiae Australiae.* Vol. 1, p. 237. (Auctoritate Guberni Coloniae Victoriae: Melbourne.))

Mueller, F.von (1864). *Fragmenta phytographiae Australiae.* Vol. 4, pp. 89–90. (Auctoritate Guberni Coloniae Victoriae: Melbourne.))

R.W. Davis

Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, WA 6983

Validation of the name *Drosera monticola* (Droseraceae), a species from the south-west of Western Australia.

Drosera monticola (Lowrie & N.G.Marchant) Lowrie was first described as *Drosera stolonifera* Endl. subsp. *monticola* Lowrie & N.G.Marchant in 1992 (Lowrie & Marchant 1992). It was raised to species status as *Drosera monticola* by Lowrie (2005). However, this combination is a *nomen invalidum* under Art. 33.4 of the *International Code of Botanical Nomenclature* (McNeill *et al.* 2006) because the page number given for the basionym was incorrectly quoted as 'pages 323–332' (the pagination range of the whole paper), rather than 'page 326' (the page of the basionym's protologue). This oversight is hereby rectified and the combination *Drosera monticola* formally validated.

Drosera monticola (Lowrie & N.G.Marchant) Lowrie, *stat. nov.*

Drosera stolonifera subsp. *monticola* Lowrie & N.G.Marchant, *Nuytsia* 8(3): 326 (1992). *Type*: Summit of Toolbrunup Peak, Stirling Range National Park, Western Australia, 14 November 1989, *P. Mann s.n.* (*holo*: PERTH 02642964).

References:

Lowrie, A. & Marchant, N.G. (1992). Four new *Drosera* taxa from south western Australia. *Nuytsia* 8(3): 323–332.

Lowrie, A. (2005). A taxonomic revision of *Drosera* section *Stolonifera* (Droseraceae), from south-west Western Australia. *Nuytsia*15(3): 355–393.

McNeill, J., Barrie, F.R., Burdet, H.M., Demoulin, V., Hawksworth, D.L., Marhold, K., Nicolson, D.H., Prado, J., Silva, P.C., Skog, J.E., Wiersema, J.H. & Turland, N.J. (eds) (2006). *International Code of Botanical Nomenclature* (*Vienna Code*). Regnum Vegetabile vol. 146. (A.R.G. Gantner: Ruggell, Liechenstein.)

Allen Lowrie

6 Glenn Place, Duncraig, Western Australia 6023
Email: Allen.lowrie@bigpond.com

Melaleuca marginata, a new name for *Melaleuca coronicarpa* (Myrtaceae)

During the preparation of a manuscript describing new species of *Astroloma* R.Br. from Western Australia, the first author had cause to examine type material of *Astroloma marginatum* Sond. obtained on loan from the National Herbarium of Victoria. Sonder (1845) had based the name on a sterile collection made by Preiss in the western wheatbelt, probably in the Toodyay–Bolgart area. When Bentham (1868) tentatively synonymised *A. marginatum* under *A. divaricatum* Sond. (= *A. epacridis* (DC.) Druce), he made the comment 'if an *Astroloma* at all, may be this species'. His doubts were well-founded. Although the type specimen examined by the first author (originally from Sonder's own herbarium) is indeed sterile, apart from what appear to be galled fruit, the detail of the leaf morphology, including the presence and distribution of oil glands, is clearly that of *Melaleuca coronicarpa* D.A.Herb. It seems likely that it was the combination of relatively indistinct oil glands, pungent leaf apices (a characteristic of all *Astroloma* species but not common in *Melaleuca*) and a similar, parallel leaf venation that misled Sonder as to the true identity of this collection.

In an enumeration of the species of *Melaleuca* in Australia by Craven and Lepschi (1999) the species was treated as *M. coronicarpa*, a name published by Herbert (1922). As *A. marginatum* is an earlier name than *M. coronicarpa*, the new combination *M. marginata* (Sond.) Hislop, Lepschi & Craven is made. While the type material of *Melaleuca marginata* is undeniably poor, and the name not particularly apt for the species, the case for conserving *M. coronicarpa* is weak. There is certainly no history of sustained usage in this case. The name does not seem to have been applied at all before the late 1980's when B.A. Barlow (CANB, then working on *Melaleuca*) began to use it on specimen determinations.

Melaleuca marginata is a widespread and common species in the wheatbelt regions of Western Australia. It occurs from the Arrowsmith River district south to the Ongerup area and inland to the Koorda and Grass Patch districts and is found in open woodland, mallee-*Melaleuca* scrub, shrubland, low open heath, on clay, sand, red-brown loam, sandy loam over laterite, and sand over granite. The lateral, capitate, white-flowered inflorescences are followed by clusters of persistent, woody fruit and these features, together with the prickly nature of the leaves, are characteristic of the species.

Melaleuca marginata (Sond.) Hislop, Lepschi & Craven, *comb. nov.*

Astroloma marginatum Sond. in Lehm., *Pl. Preiss.* 1: 299 (1845). *Type*: In solo glareoso sterili silvae prope fontem Pitscharding, Victoria [according to Marchant (1990) Pitscharding Spring is an unknown locality in the county of Victoria, a nineteenth century name for an area which approximately corresponds to the modern shires of Toodyay and Victoria Plains in Western Australia], 20 March 1840, *L. Preiss* 471 (*holo*: MEL 2181123!).

Melaleuca coronicarpa D.A.Herb., *J. & Proc. Roy. Soc. Western Australia* 8: 35 (1922), as *Melalenca*. *Type*: Western Australia: Bruce Rock, on the road to Merredin, November 1920, *Wilson & Herbert* 152 *(holo*: PERTH 01638777!; *iso*: MEL!).

Notes. B.A. Barlow (unpublished data) has indicated that the name *M. cardiophylla* var. *parviflora* Benth. (Bentham 1867) is a synonym of *M. coronicarpa*. However, lectotypification of this name is clearly desirable as some of the syntypes are from localities well outside the geographic range of *M. marginata* and will almost certainly be referable to other taxa. The syntypes in question, all unseen by us, are: Western Australia: Swan River, *Drummond* 1st coll. *s.n.* (*syn*: K); Murchison river, *Oldfield s.n.* (*syn*: K); Shark Bay, *Denham s.n.* (*syn*: K); Dirk Hartog Island, *Milne s.n.* (*syn*: K); Bay of Rest, NW coast, *Cunningham s.n.* (*syn*: K).

Acknowledgments

The directors and/or curators of the herbaria CANB, MEL and PERTH are thanked for the opportunity to study collections in their care.

References

Bentham, G. (1867). *Flora Australiensis. Vol.* 3, p. 135 (Reeve: London.)

Bentham, G. (1868). *Flora Australiensis. Vol.* 4, p. 156-157 (Reeve: London.)

Craven, L.A. & Lepschi, B.J. (1999). Enumeration of the species and infraspecific taxa of *Melaleuca* (Myrtaceae) occurring in Australia and Tasmania. *Australian Systematic Botany* 12: 819–927.

Herbert, D.A. (1922). Contributions to the flora of Western Australia. No. 4. *Journal and Proceedings of the Royal Society of Western Australia* 8: 35–41.

Marchant, N.G. (1990). *In*: Short, P.S. (ed.), *History of systematic botany in Australasia*, p. 131–135 (Australian Systematic Botany Society: South Yarra, Vic.)

Sonder, O.W. (1845). Epacridaceae. *In*: Lehmann, J.G.C. (ed.) *Plantae Preissianae*. Vol. 1, p. 299 (Sumptibus Meissneri: Hamburg.)

Michael Hislop[1], Brendan J. Lepschi[2] and Lyn A. Craven[2]

[1]Western Australian Herbarium, Department of Environment and Conservation,
Locked Bag 104, Bentley Delivery Centre, WA 6983

[2]Australian National Herbarium, CSIRO Plant Industry,
GPO Box 1600, Canberra, ACT 2601.

Corrections

Vol. 21(2)

On page 59, the paragraph under the heading *Notes* should be placed after the paragraph under the heading *Illustrations.* The pdf version has been corrected.

On page 71, the specific epithet for the new taxon *Stackhousia stratfordii* W.R.Barker & Cockerton should be corrected to *stratfordiae* to agree with the gender of the person after whom it is named, Ms Kirsty Stratford. The authors are grateful to the several people who so promptly informed us of the mistake and to the good humour with which Ms Stratford took the news of her new gender.

Vol. 20

On page 98, the subspecific epithet for the new taxon *Stylidium acuminatum* (Carlquist) Wege subsp. *meridionalis* Wege should be corrected to *meridionale* to agree with the neuter gender of *Stylidium.*

Royal Botanic Gardens Victoria
RBG00025223

CONSERVATION CODES FOR WESTERN AUSTRALIAN FLORA

T: Threatened Flora (Declared Rare Flora — Extant). Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the *Wildlife Conservation Act 1950*). Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria:

CR: Critically Endangered – considered to be facing an extremely high risk of extinction in the wild.
EN: Endangered – considered to be facing a very high risk of extinction in the wild.
VU: Vulnerable – considered to be facing a high risk of extinction in the wild.

X: Presumed Extinct Flora (Declared Rare Flora — Extinct). Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the *Wildlife Conservation Act 1950*).

1: Priority One: Poorly-known taxa. Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

2: Priority Two: Poorly-known taxa. Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.

3: Priority Three: Poorly-known taxa. Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

4: Priority Four: Rare, Near Threatened and other taxa in need of monitoring.

Rare: taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.

Near Threatened: taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. Taxa that have been removed from the list of threatened taxa during the past five years for reasons other than taxonomy.

5: Priority Five: Conservation Dependent taxa. Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxa becoming threatened within five years.

CONTENTS

Papers

Labichea rossii (Fabaceae: Caesalpinioideae), a new species from the Yilgarn Ranges, Western Australia. N. Gibson 91

A new and rare species of *Ptilotus* (Amaranthaceae) from a suburban wetland of the eastern Swan Coastal Plain, Western Australia. R.W. Davis and C. Tauss 97

An assessment of some infraspecific taxa in *Ptilotus* (Amaranthaceae) from Western Australia. R.W. Davis 103

A revision of *Dielsiodoxa* (Ericaceae: Styphelioideae: Oligarrheneae). D.E. Albrecht and M. Hislop 107

Sida picklesiana (Malvaceae), a new species from the Murchison-Gascoyne region of Western Australia. A.S. Markey, S. Dillon, G.T.B. Cockerton and R.M. Barker 127

Two species of *Inocybe* (fungi) introduced into Western Australia. N.L. Bougher and P.B. Matheny 139

Short Communication

Re-evaluation of some infraspecific taxa in *Ptilotus* (Amaranthaceae). R.W. Davis 149

Validation of the name *Drosera monticola* (Droseraceae), a species from the south-west of Western Australia. A. Lowrie 152

Melaleuca marginata, a new name for *Melaleuca coronicarpa* (Myrtaceae). M. Hislop, B.J. Lepschi and L.A. Craven 153

Corrections 155

ISSN 0085-4417
Print Post approved PP665002/00003